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   The main purpose should be to ... describe instrument function | describe applications of instrument function | describe menus in: order of appearance /alphabetical order

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Further comments on the operating manual:

SF-60
PDH/SDH Error and Jitter Analyzer

BN 3017/01, Series K ...
from Software Version 4.100

Operating Manual

Wandel & Goltermann
Electronic Measurement Technology

Please direct all enquiries to your local Wandel & Goltermann sales company. The addresses are given at the end of this handbook.

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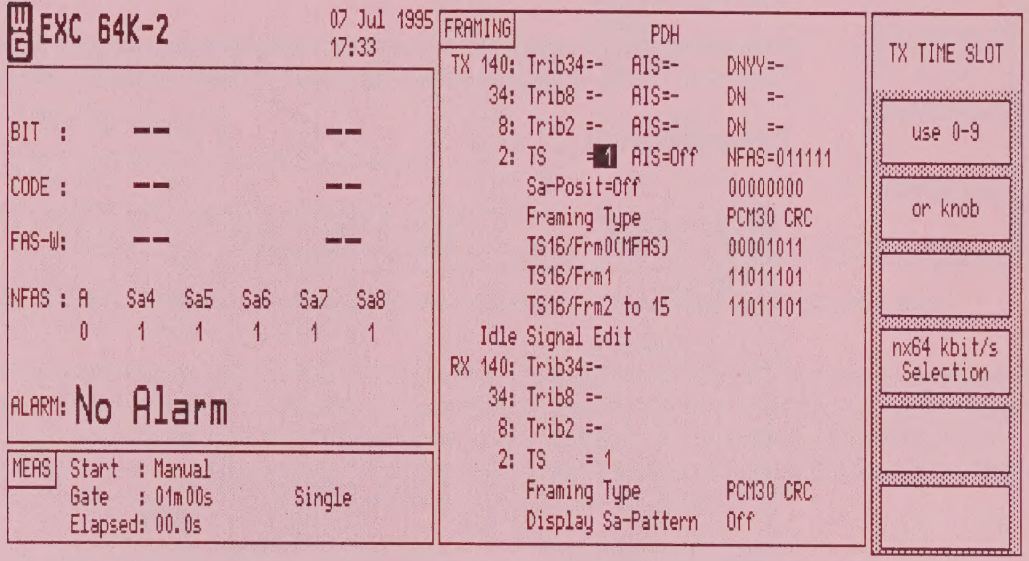
Addendum to SF-60, Operating Manual, BN 3017

Re: section 3.3.5.5 n x 64 kbit/s (Option BN 3017/00.07, from Software Version 4.100)

Setting a channel capacity of n times 64 kbit/s in a 2 Mbit/s frame is done in the "PDH frame" menu page.

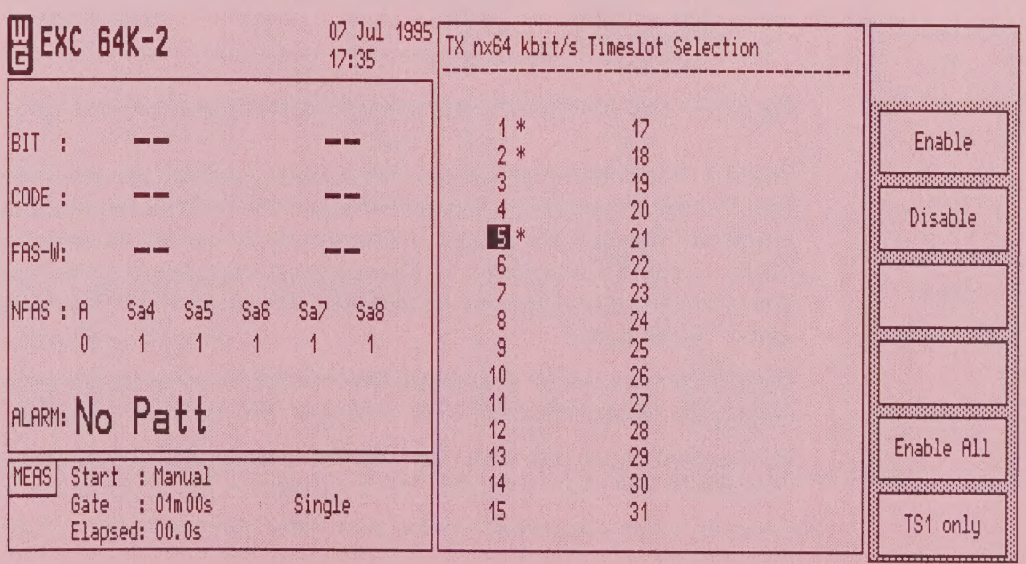
This page is opened from the "TX/RX frame" menu item in the main menu for PDH applications.

For SDH applications, this menu point ("TX/RX frame") first opens the "SDH frame" menu page. Clicking "PDH" on this page opens the "PDH frame" menu page.



"PDH frame" menu page

Press key F4 to enable customized 64 kbit/s channel assignment.



"TX n x 64 kbit/s Timeslot Selection" menu page

Channel capacity can consist of any independent channels.

Channels are activated by the "Enable" action button and deactivated by the "Disable" action button.

3.3.6.4 Evaluation to M.2100 (Option BN 3017/00.52, from Software version 4.100)

The SF-60 performs transmission quality analysis to M.2100 on framed PDH signals and unframed signals at up to 140 Mbit/s.

M.2100 evaluation is selected under "Analysis" in the "Measurement" menu.
The corresponding results display is activated in the "Result format" menu by selecting "Left -hand window".

Evaluations can be performed as standard measurements using the M.2100 limit values in "Standard" mode. Other limit values can be set in "User" mode for non-standard applications.

1) Standard mode

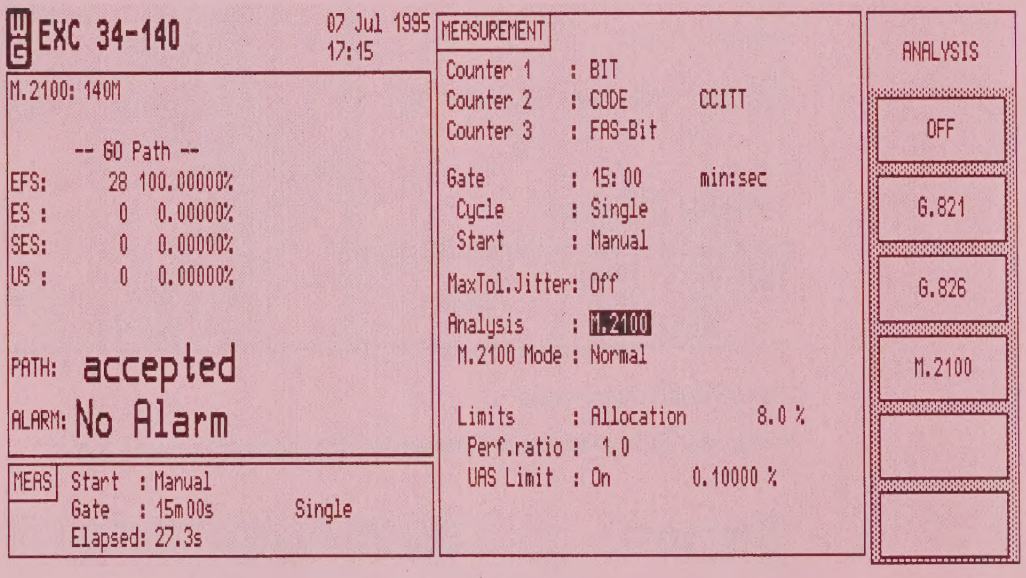


Fig. 1 M.2100: Standard analysis taking individual path length into account

The M.2100 standard measurement is selected by entering the path length in the "Limits" dialog line. The actual path length as a percentage of the hypothetical reference length of 27,500 km is entered. The "Weighting factor" parameter allows the M.2100 limits to be tightened (factor < 1) or relaxed (factor > 1). The instrument compares the results with the specified limits, taking measurement time and frame system into account, and determines the path status (good, doubtful, bad).

By specifying a value for unavailable seconds (UAS), these can be allowed during assessment of the path (not included in M.2100; UAS limit OFF, standard value = 0).

In "Standard" mode with limits "Off", the instrument performs a quality measurement without comparison with the limit values. This is indicated in the results by the message "Path: Off".

2a) User mode

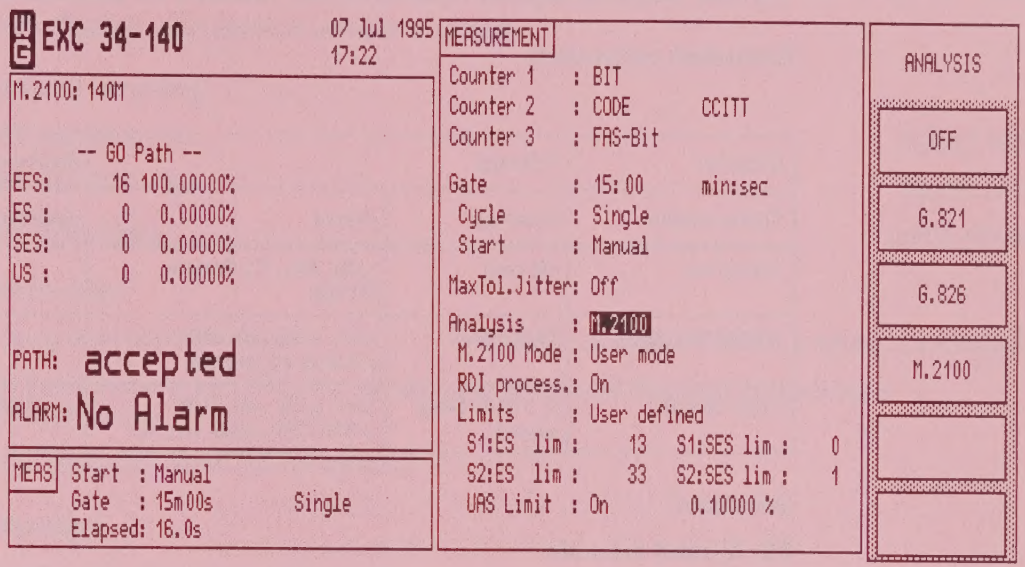


Fig. 2 M.2100 analysis in "User" mode using customized limit values for evaluating path status

User mode allows you to customize the quality limits for the following: ES (errored seconds) and SES (severely errored seconds). The value for the S2 limit must always be greater than or equal to the value for the S1 limit (any other entries are impossible). For higher order systems and PCM 30 systems a RDI (remote defect indication) signal can also be evaluated as a defect. The UAS limit switch can be used to influence path rejection as above.

2b) User mode for a PCM 30 CRC path

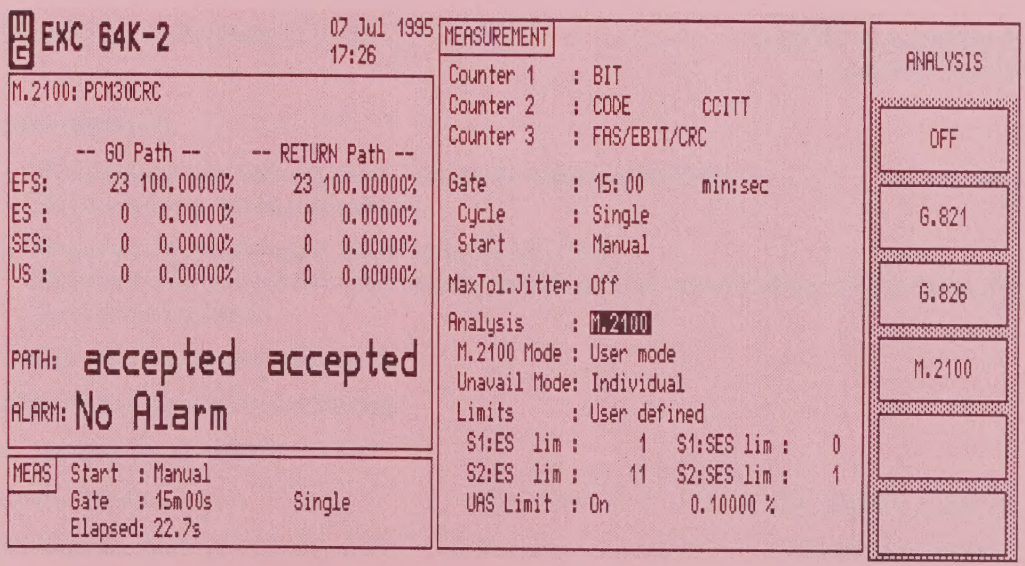


Fig. 3 M.2100 analysis: "User" mode, taking individual path lengths into account

PCM 30 CRC systems are evaluated in the forward and backward direction. You can select whether the unavailable seconds (UAS) for the two paths are assessed separately or together. The UAS results are logically ORed when both directions are assessed together.

Evaluation parameters

Direction	Forward		Backward	
Frame system	Anomaly	Defect	Anomaly	Defect
Unframed	Bit error	LOS, AIS, No Pattern, Bit Slip		
2/8/34/140 Mbit/s	FAS errors	LOF, LOS, AIS, RDI, n frame bit errors/s,		
PCM 30 CRC	≥ 1 CRC block error/s	LOF, LOS, AIS, RDI, ≥ 805 CRC block error/s	≥ 1 E-bit/s	≥ 805 E-bit/s

Definitions:

ES: Errored seconds

A second containing at least one anomaly.

EFS: Error free second

SES: Severely errored seconds

A second containing at least one defect.

US: Unavailable seconds

Starts with 10 consecutive SES (which count towards unavailable time) and ends after 10 consecutive non-SES (which count towards available time).

8.2.6.6 Evaluation as per ITU-T M.2100 (Option BN 3017/00.52)

Evaluation parameters . . . . . ES, EFS, SES, UAS

Specification as an absolute value or a percent.

Overall weighting

ES and SES ≤ S1 . . . . . ACCEPTED

ES and SES ≥ S2 . . . . . REJECTED

All other cases . . . . . .UNCERTAIN

Evaluation

Using selectable hierarchy . . . . . .140 Mbit/s, 34 Mbit/s, 8 Mbit/s, 2 Mbit/s, n x 64 kbit/s

In frame systems with CRC, the forwards and backwards directions are evaluated simultaneously.

The evaluation mode can be selected:

Standard

Limit monitoring can be switched off.

With the limit monitoring switched on:

- Automatic computation of threshold values S1 and S2 for ES and SES.

The threshold values depend on the measurement time, path length and a weighting factor.

Path share of the reference path . . . . . 0.1 to 100 %, stepsize 0.1 %

Weighting factor. . . . . .0.1 to 10, stepsize 0.1

- UAS limit monitoring can be switched off, i.e. UAS ignored in the overall assessment.

With UAS limit monitoring switched on:

Settable threshold values for UAS . . . . . 0.00000 % to 9.99999 %
. . . . . stepsize 0.00001 %

User-definable

- RDI processing in frame systems (except for 2 Mbit/s with CRC)
  RDI processing can be switched off.
- Unavailability processing in frame systems with CRC
  Separate (individual) or common (global) weighting of the unavailability in the forwards and backwards directions.

Limit monitoring can be switched off.

With the limit monitoring switched on:

- Settable thresholds:

S1-ES, S2-ES . . . . . 0 to 999999, stepsize 1

S1-SES, S2-SES . . . . . .0 to 99999, stepsize 1

- UAS limit monitoring as in "Standard" mode.

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1 Introduction

Application

The SF-60 is used for error measurements and generating jitter for SDH, PDH and ISDN transmission systems from 48 kbit/s to 175 Mbit/s, as well as for testing network nodes. The modular construction makes it possible to expand the instrument from a simple unframed bit error tester right up to a combined PDH/SDH tester with jitter generator and optical interface. Remote control via the IEEE bus or V.24 interface is provided to allow integration into automatic test systems.

The SF-60 measures the following

- Bit errors
- Code errors
- Block errors

With options

- Frame errors
- CRC check sum errors
- Tolerance to jitter

Characterstics

Generator

- Synthesizer generates internal clock:
  Offset range ± 999 ppm,
  settable in steps of 1 ppm
- Selectable codes:
  HDB 3, CMI, AMI, B3ZS, CMI inverted, RZ, NRZ (75 Ω output),
  HDB 3 (120 Ω balanced output)
- Test patterns:
  Pseudo-random bit sequences from 2^6-1 to 2^{31}-1,
  4 programmable digital words from 1 to 32 bits in length for testing coders,
  Toggled, programmable 2 x 8 bit word for testing clock recovery circuits
- Error insertion for simulating real operating conditions and for testing error evaluation circuits:
  One-shot triggering (external or internal) with programmable error rate or burst triggering with programmable duration
- Options:
  – 2 Hz to 4.5 MHz jitter generator with jitter amplitude from 0 to 20 UI
  Signals with frame structures to ITU-T (formerly: CCITT) Recommendations:
  – SDH frames (STM-1 VC-4, STM-1 VC-12, STM-1 VC3)
  – PDH frames at 2, 8 or 34 MBit/s,
  – PDH frames at 140 Mbit/s,
  – PDH multiplex chain
  – Quad output,
  – Optical interface (as alternative to quad output)

Receiver

- Measures bit errors, block errors and code errors (absolute or rate measurements)
- Error evaluation to ITU-T Rec. G.821
- Recognition and registration of pattern slip
- Signal delay time measurement
- Monitoring of signal, clock pattern synchronization, AIS
- Built-in clock recovery for all bit rates
- Timer operation for starting measurements at a given time

- Options:
  - Measurement of frame alignment signal errors and justification rate (PDH options),
  - Measurement of tolerance to jitter (jitter generator option),
  - Evaluation of B1, B2 and B3 parity errors (SDH option),
  - Evaluation of pointer increments and decrements (SDH option).
  - Evaluation to ITU-T G.826, in-service.

Complete instrument

- Large easy-to-read LC display,
- Built-in thermal printer for documenting results, alarms and settings,
- Internal memory for 10 programmable, pre-set device settings (setups); number of setups extendable using RAM cards, each S64k RAM card storing up to 20 setups.

Connections to external devices

- V.24 serial interface for remote control,
- IEEE 488/IEC 625 interface for remote control.

Areas of use

The most important uses of the SF-60 are in:

- Troubleshooting and servicing
- production and acceptance testing,and
- research and development

on synchronous and plesiochronous digital transmission systems. The instrument is especially suitable for long-term measurements, even if jitter and frequency offset are present. The wide range of selection functions allow concentration on the evaluation and printout of the important results. Remote control and communications facilities allow the SF-60 to be completely integrated into ATE systems.

The SF-60 can also be used to test network nodes, as it incorporates all the necessary functions for commissioning such nodes.

1.1 Block diagrams

The main functional groups of the SF-60 are:

- Generator
- Receiver
- CPU
- Display
- Printer
- Power supply

The following block diagrams show the main components of the generator and receiver.

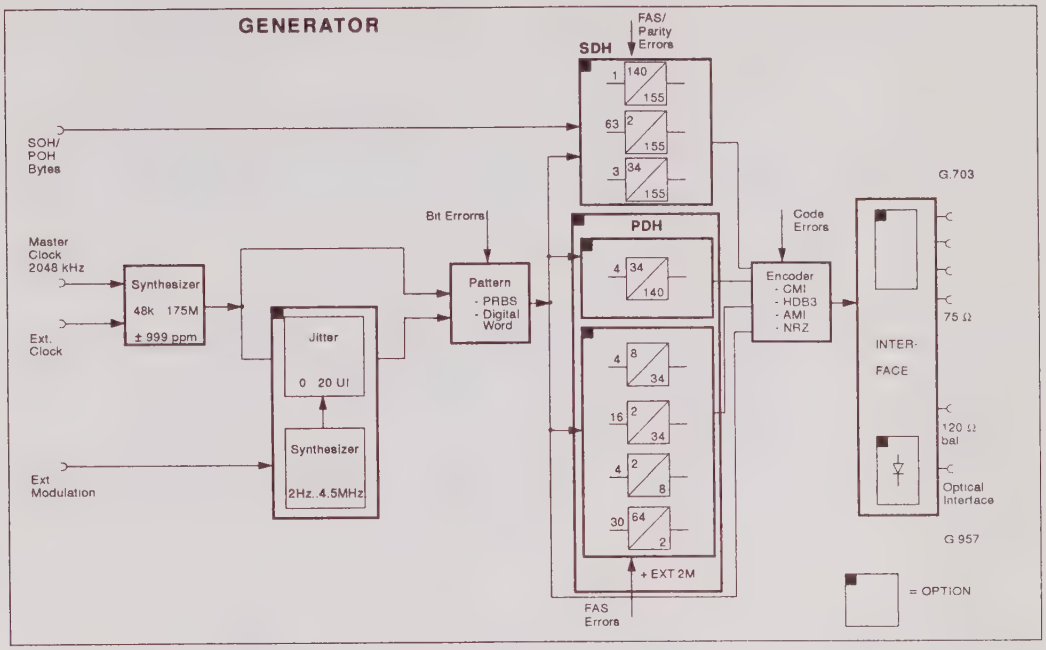


Fig. 1-1 Generator block diagram

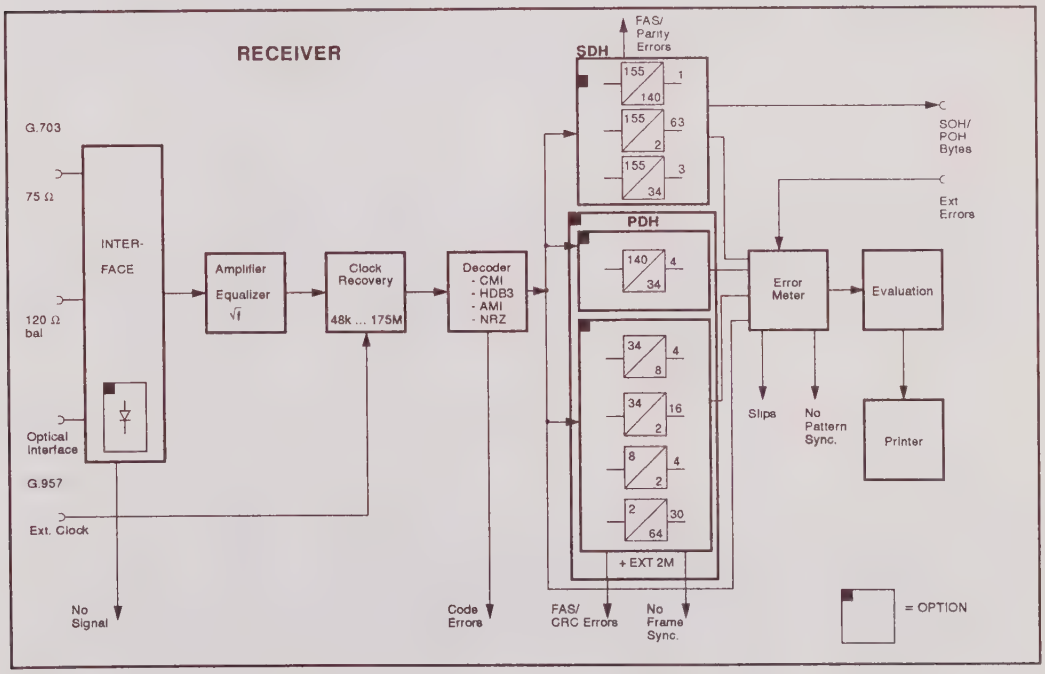


Fig. 1-2 Receiver block diagram

2 Important information

2.1 Important safety instructions

This instrument left the factory in perfect condition. To ensure that this condition is maintained and that operation hazards are eliminated, follow the instructions below carefully.

2.1.1 Correct usage

The SF-60 must not be used under any conditions or for any purpose other than those for which it is intended, as indicated by the specifications (section 8 of this manual) and the introduction (section 1).

Failure to observe this instruction may be dangerous and may result in damage to the instrument. Refer also to section 2.1.5 "Faults and excessive stresses".

Do not connect the instrument to circuits for which it is not equipped.

2.1.2 Operating voltage

The SF-60 can be set for operation from nominal AC line voltages of 220 V (220 to 240 V) and 110 V (100 to 127 V) using the voltage selector switch on the back panel. The ex-works setting is 220 V.

Make sure that the selector switch is set to the nominal value of the local AC line supply voltage before switching the instrument on.

The SF-60 may only be operated from AC power supplies having a nominal frequency of 50 or 60 Hz.

2.1.3 Optical interface (option)

When equipped with the optical interface, the SF-60 is a class 1 laser device as defined by IEC 825. The safety procedures outlined in this standard also require that a label with the wording "CLASS 1 LASER PRODUCT" is affixed to the instrument. If the interface is retrofitted by the user, an appropriate label which can be attached to the SF-60 to conform with the standard is supplied with the option. The label has the following appearance:

The dust caps on the input [39] and output [38] of the interface are provided for protection of the fiber end faces from dust or damage. The caps should be screwed on to the connectors whenever the instrument is moved or not in use, only being removed when measurements using the optical interface are to be made. If adapters are used, these should not be left attached to the connectors but should be removed and replaced with the dust caps on completion of the measurements.

2.1.4 Safety class

The SF-60 is a safety class 1 equipment as defined by EN 61010-1 (IEC Publication 1010-1). The line cord provided with the instrument includes a protective ground conductor. The instrument should only be connected to AC power outlets equipped with a protective ground contact unless the supply is specially isolated.

Under no circumstances should the protective ground conductor be interrupted inside or outside the instrument.

Before the instrument is connected to measuring circuits in which dangerous voltages are present, a protective ground connection must be made.

If the protective ground circuit of the AC line can be used for this purpose, the instrument must be connected to the AC line before it is connected to the measuring circuit.

If the measuring circuit is equipped with a protective ground conductor, this must be connected to the instrument casing before the rest of the measuring circuit is connected.

2.1.5 Faults and excessive stresses

The instrument must be taken out of service and secured against unintentional operation if:

- it is visibly damaged
- it no longer operates correctly
- it has been used under conditions outside the permitted range limits
- it has been subjected to excessive stresses due to long-term storage under unsuitable conditions or due to rough handling in transport; refer to section 2.2 "Packing and unpacking the instrument, transport" for further information.

Failure to observe this instruction may be dangerous.

Contact your local Wandel & Goltermann Service Center (see inside cover page of this manual for addresses) for advice.

2.1.6 Instructions for repairs and maintenance

Parts carrying live voltages may be exposed when the covers are opened or parts are removed.

Before opening the instrument, disconnect it from all power sources.

Capacitors in the instrument may remain charged even if the instrument is disconnected from all power sources.

If calibration, maintenance or repairs on the opened instrument under power are unavoidable, such operations should only be performed by qualified personnel familiar with the risks involved.

Repairs

Repairs should only be carried out by competent personnel. No constructional feature of the instrument may be modified in any way which reduces operational safety. Creepage and air-paths and insulation thickness in particular must not be reduced.

If possible, use original spare parts for replacing defective components. Other spares may be used only if they do not adversely affect the safety characteristics of the instrument.

Fuses

Only the prescribed fuses may be used. See section 2.4 "Power supply".

Tests after repairs or maintenance

After repairs or maintenance, the condition of the protective ground conductor shall be checked visually and the resistance between the protective ground contact of the instrument's a.c. line plug and the instrument casing (ground socket) shall be measured. The protective ground conductor resistance shall be below 0.1 Ω. The line cord shall be moved during the measurement. Any changes in resistance indicate damage to the line cord. A damaged line cord must not be used.

If a further measurement with a new line cord indicates that the line cord itself is not faulty, the instrument shall be disabled and the cause of the resistance changes identified and repaired to conform with the above safety regulations.

The insulation resistance between the protective ground contact and the a.c. line contacts (shorted together) of the instrument's a.c. line plug shall be measured using a 500 V d.c. insulation tester. The instrument's power switch shall be on ("I" position) for the test. The insulation resistance shall be more than 2 MΩ. If a value below 2 MΩ is indicated, the instrument shall be repaired and re-tested before use.

2.2 Packing and unpacking the instrument, transport

2.2.1 Unpacking

Retain the original packing for possible future use. It is designed for re-use unless badly damaged by extremely rough handling. It will ensure that the instrument is correctly protected against damage should it become necessary to transport the instrument at some time.

2.2.2 Checking for transport damage

Check the instrument for transport damage. If the packaging shows considerable signs of damage, it is likely that the instrument has also been damaged. Do not attempt to operate an instrument which is visibly damaged, as this may be dangerous and may result in further damage to the instrument (refer also to section 2.1, "Important safety instructions").

2.2.3 Packing, transport and storage

When the instrument is to be transported (e.g. when returning it to a W & G service center for repairs), please follow the instructions below.

Packing

The original packing should be used if possible.

If the original packing is no longer available, use a box made from double-layer corrugated cardboard with a wall thickness of at least 4 mm.

The box should be dimensioned such that space for at least 70 mm of padding on all sides of the instrument is available. Rigid plastic foam or corrugated cardboard is suitable as padding.

The padding must ensure that the instrument cannot shift position in the box and as large an area as possible of the instrument should be padded. Any free space in the box may be filled with polystyrene chips.

Polystyrene chips alone are not suitable for use as padding.

Use fiber-reinforced, water-resistant self-adhesive tape at least 70 mm wide to seal the box along the butt edges.

Storage under damp conditions

If the instrument is to be subjected to damp conditions during a long period of transport or storage it is a good idea to re-use the silica-gel drying agent provided in the original packing. The sachets of drying agent should be placed with the instrument inside the plastic bag provided in the original packing and the bag sealed tightly using adhesive tape.

Do not use saturated drying agent as this may increase the humidity and cause damage.

The drying agent is blue when dehydrated and pink when saturated.

Check list

Make a list of all the parts and attach this to the box.

2.2.4 Operation after storage or transport

Storage or transport may subject the instrument to excessive stresses. Refer to sections 2.1 and all subsections of section 2.2.

Recovery time

Condensation may form on or inside an instrument which has been stored or transported at a low temperature when it is brought into a warm room. Do not switch the instrument on until any condensation visible on the surface has evaporated. Correct operation is ensured once the instrument has reached a temperature within the guaranteed operating range (+5 to +40 °C).

The last point also applies if the instrument was stored at high temperatures.

Do not switch the instrument on until it is within the operating temperature range limits.

Built-in rechargeable cells

The instrument contains two rechargeable batteries for supplying power to the modules, storing input data and for data retention in the event of an a.c. line power failure. These batteries may be fully discharged after a long period of storage. To ensure that they fulfil their designed function, the instrument must be switched on and powered from the a.c. line for at least 14 hours.

2.3 19" rack mounting

The case dimensions of the SF-60 conform to DIN 41494, IEC 297 and US Standard ASA C. 83.9. It is thus suitable for 19" rack mounting after conversion using the 19" conversion kit, BN 700/00.05, which contains all necessary parts (fixing brackets and bolts).

Warning: **Disconnect the SF-60 from all power sources before conversion. Parts carrying live voltages are exposed when the base cover is removed.**

To convert the instrument proceed as follows:

- Remove the plastic guides on the top of the instrument (undo 2 Allen screws).
- Turn the instrument over and remove the feet.
- Remove the instrument base panel (undo 6 Allen screws). Turn the base panel over and undo the 6 cross-head screws fixing the guides for the RAM card drawer.
- Remove the guides and the drawer.
- Replace the base panel on the instrument.
- Fit the 19" mounting brackets as shown in figure 2-1.
- Slide the instrument into the 19" rack and fasten it in position using the brackets.

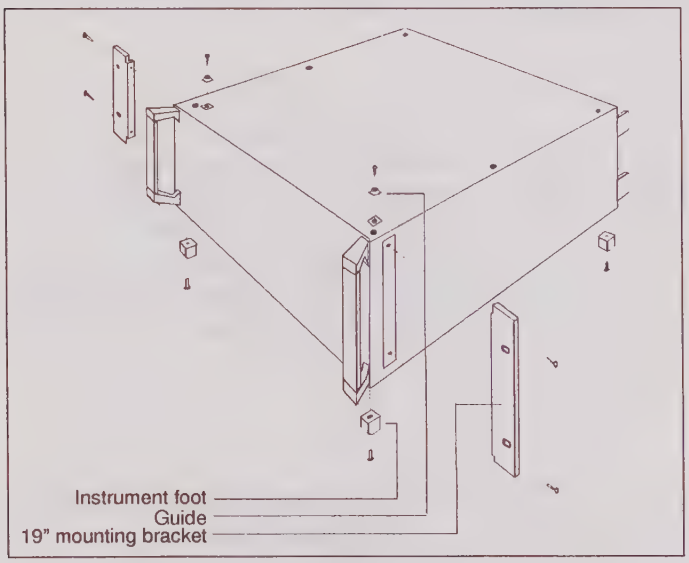


Fig. 2-1 Converting the SF-60 for 19" rack mounting

2.3.1 Ventilation

The ventilation slots should be kept free at all times.

Make sure that rack-mounted instruments are sufficiently ventilated and that the ambient temperature in the rack does not exceed +40 °C. If necessary, allow a space of 1 U (44.4 mm) above and below the instrument and use dummy panels to cover the spaces.

2.4 Power supply

2.4.1 A.C. line operation

A.C. line frequency

The SF-60 is suitable for use with AC power supplies having a nominal frequency of 50 or 60 Hz.

Fuses

The following fuse values are specified:

Voltage setting	Nominal a.c. line voltage range	Fuse value
220 V	220 to 240 V	F 5A
110 V	100 to 127 V	F 5A

Two spare fuses are provided in the accessory box located on the back panel of the instrument above the a.c. line switch.

2.4.2 NiCd rechargeable cells

This instrument contains nickel-cadmium rechargeable cells for the purpose of supplying power for data retention. These cells constitute an environmental hazard if they are not disposed of properly at the end of their life or if the instrument is scrapped.

They should be collected and sent for controlled disposal or for recycling of the constituent materials. Observe the regulations governing the disposal of such items in your country.

The removal of the NiCd rechargeable cells is described in section 7, "Calibration, maintenance and disposal".

2.4.3 Switching on

Switch the SF-60 on using the AC line switch, located in the lower left section of the back panel ("I" position). The standby switch on the front panel should then be pressed to "ON". A red indicator appears when the switch is pressed, indicating the ON status, and the yellow LED "Standby" switches off.

The SF-60 will be activated with exactly the same settings as were in use at the time it was last switched off. The operating mode and parameters will be the same.

Switch-on test routine

Each time it is switched on, the SF-60 automatically performs a short test which lasts for about 10 seconds. The following are checked:

- Batteries
- Display
- ROM
- RAM
- Interfaces

During the test, all LEDs on the front panel with the exception of the "Standby" LED will be lit. After the test, the instrument is set to exactly the same settings as were in use at the time it was last switched off. If the test detects a fault, this will be indicated by an error message (see under "Error messages" in section 3.4). If this occurs, disconnect the instrument from the a.c. line and rectify the fault.

Function check program

As well as the short switch-on test, a self-test routine or function check program (FCP) is provided, by means of which the more important functions of the instrument can be checked automatically when the generator [30] is connected to the receiver [36].

Note: The function check program automatically makes instrument settings for performing the various tests. Any settings selected before running the check program will therefore be replaced by the settings used for performing the last test in the check program.

To run the function check program, proceed as follows:

- Switch on the instrument as described above.
- The function check program can be run when the switch-on test has been completed successfully
- If the results of the function check program are to be recorded and output as hardcopy, set the printer to "AUTO" (main menu F6, F2) before starting the check program.
- Press the "TEST/CONF" (test and configuration) key located below the LC display
- Press key F2 ("Self Test")

The self-test menu will be displayed. Here you can select whether the complete self-test routine is to be performed or certain tests only (see figure 2-2), and how many times the test is to be made.

Test number	Test type	Option
1 to 3	General tests	
7 to 9	Amplitude	
10 to 13	Frequency	
14 to 16	Alarms	
20 to 29	Patterns	
30 to 51	Error insertion, codes	
60	Delay measurement	
70 to 83	PCM 1920 frame (140 Mbit/s)	•
90 to 103, 107	PCM 480 frame (34 Mbit/s)	•
120 to 137	PCM 30 CRC frame (2 Mbit/s CRC)	•
140	PCM 30 frame (2 Mbit/s)	•
145 to 148	2 Mbit/s filler channels	•
150 to 153	Modulator	•
160 to 175	Tolerance to jitter	•
180 to 186	STM-1 frame C-4	•
200 to 204, 209	STM-1 frame C-12	•
205 to 208, 210	STM-1 frame C-3	•
220 to 232	PCM 120 frame (8 Mbit/s)	•
240 to 243, 246 to 249	MUX/DEMUX chain frame	•

Fig. 2-2 Self-test table

2.4.4 Default setting

If the instrument memory is disconnected from the rechargeable batteries (e.g. when these are exchanged), an undefined instrument setting may result. By carrying out a reset (initialization), a defined setting is made. This should also be done if the instrument "crashes" for any reason. To reset the instrument, proceed as follows:

- Connect the instrument to the a.c. line.
- Switch the a.c. line switch on the back panel to ON ("I" position).
- Switch the "Standby" switch on the front panel to OFF (switch indicator panel is black, yellow "STANDBY" LED is on).
- Press the "CLEAR" switch and hold it down, at the same time switching the "Standby" switch to ON (LED goes out, switch indicator panel is red).
- Hold down the "CLEAR" switch until the display starts to indicate the results of the switch-on routine (Wandel & Goltermann SF-60, Self-test ROM ... ok, Self-test RAM ... ok). This takes about 4 seconds from the time that the "Standby" switch is pressed.

The instrument is now set to the default settings, with all parameters set to specific values (see figure 2-3, "Default setting, printer output"). Any previously stored setups are erased and the date and time are also reset (01 Jan 1992, 00:00:01).

```
SF-60          01 JAN 92
SETUP LIST     00:00:15
ACTUAL SETUP
GENERAL    |   TX    |   RX
TX/RX-Mode |   TX    =   RX
BR/kbit/s  | 139264  | 139264
CLOCK      |   INT   | SIGNAL
OFFS./ppm  |   cal   |   --
CODE       | CMI/C   | CMI/C
FRAME      |   --    |   --
JITTER     |  OFF    |
PATTERN    | PRS23   | PRS23
MEASUREMENT
ERR.INS.  :OFF   BIT/SINGLE
EQUALIZER : OFF
MICRO INT. THRESH >  1000us
ERROR-COUNTER :
  1:BIT    2:CODE   3:BLOC
GATE  :  1min 0s     SINGLE
PERF. G.821:OFF
PRINTER:MAN
MAX. TOLERABLE JITTER : OFF
 THRESHLD CD-ER  :>  10
 DELAY           :  1.0s
```

Fig. 2-3 Default setting, printer output

2.5 Data media

2.5.1 Memory card

Application

As well as the so-called "Presets" (fixed settings for certain applications), up to 10 setups (variable settings) can be stored in the internal memory. Further setups can be stored externally on memory cards. One S64K memory card is provided with the SF-60; this one can store up to 20 setups. Further memory cards can be ordered at extra cost from Wandel & Goltermann using the order number BN 2110/00.02 (refer to section 8.11.7 for ordering information).

The slot for the memory card is marked "MEMORY CARD" and is located on the front panel of the SF-60 to the right of the printer. When inserting the memory card, the label on the card should be to the left, with the arrow pointing towards the MEMORY CARD slot.

2.6 Data retention

Two 1.2 V rechargeable NiCd batteries are provided on the CPU board to retain the data when the instrument is switched off. They are automatically trickle-charged when the instrument is operated from the a.c. line. When the batteries are fully charged, data will be retained for a period of approximately 24 days. The battery life is approximately 5 years.

The current device settings and setups are stored in a memory which is buffered by these two batteries.

2.7 Printer

The built-in thermal printer requires no maintenance.

Paper rolls can be ordered from Wandel & Goltermann. See section 8.11.7 for ordering details.

To fit a new roll of paper, proceed as follows (refer to figure 2-4):

1. Slide the printer module out as far as it will go
2. Lift the cover
3. Remove the securing clip and remove the empty roll
4. Push the spindle into the new roll (not illustrated)
5. Insert the new roll and the securing clip
6. Thread the paper into the slot
7. With the instrument switched on, press the "STOP/PAPER" key until paper appears at the exit slot
8. Close the lid
9. Slide the printer module back into the instrument.

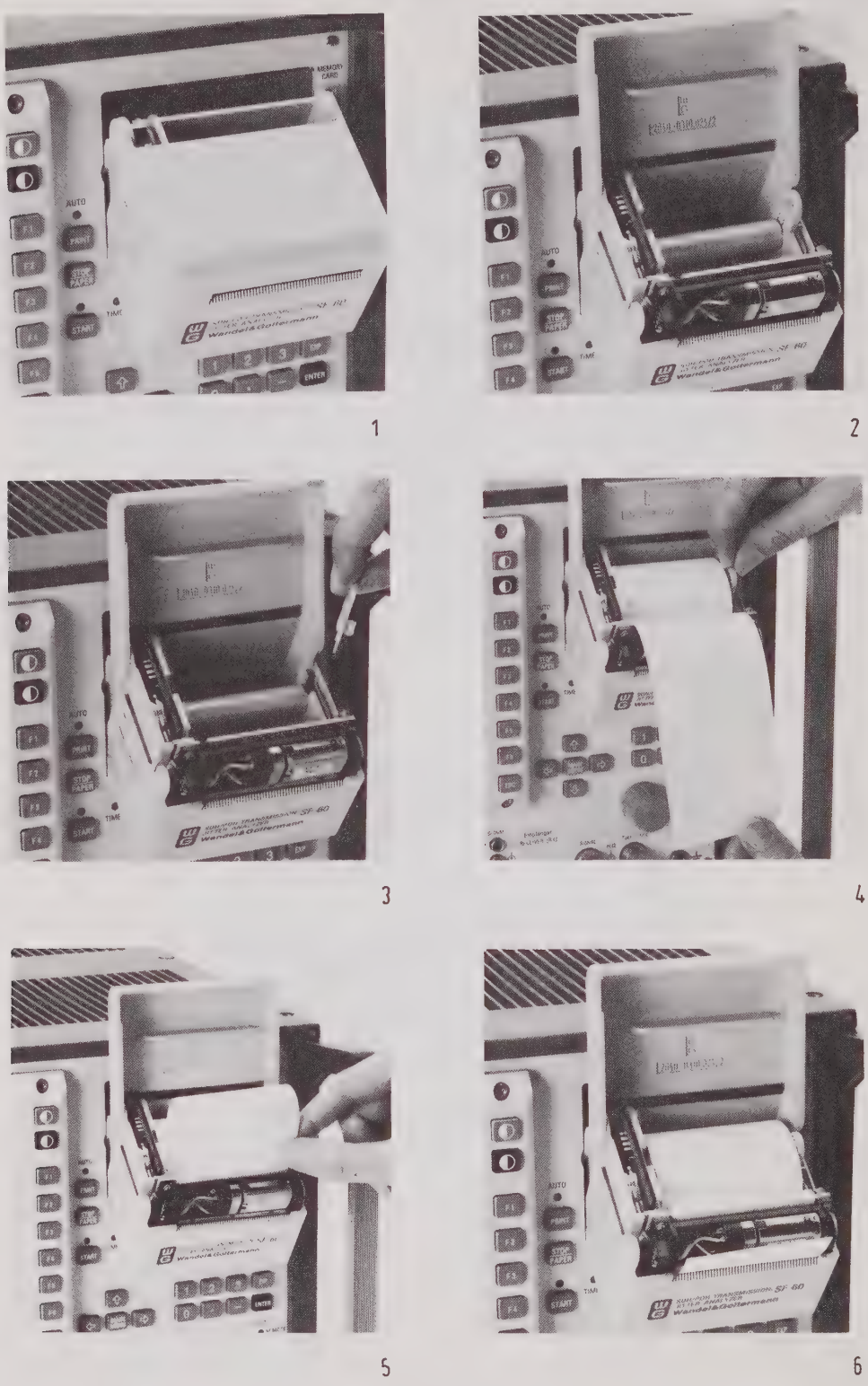
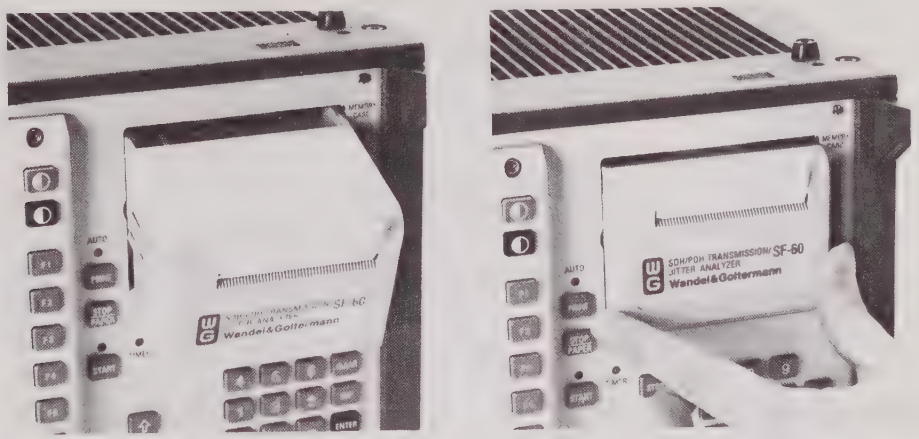


Fig. 2-4 Changing the paper roll (continued overleaf)



7 8

Fig. 2-4 Changing the paper roll (continuation)

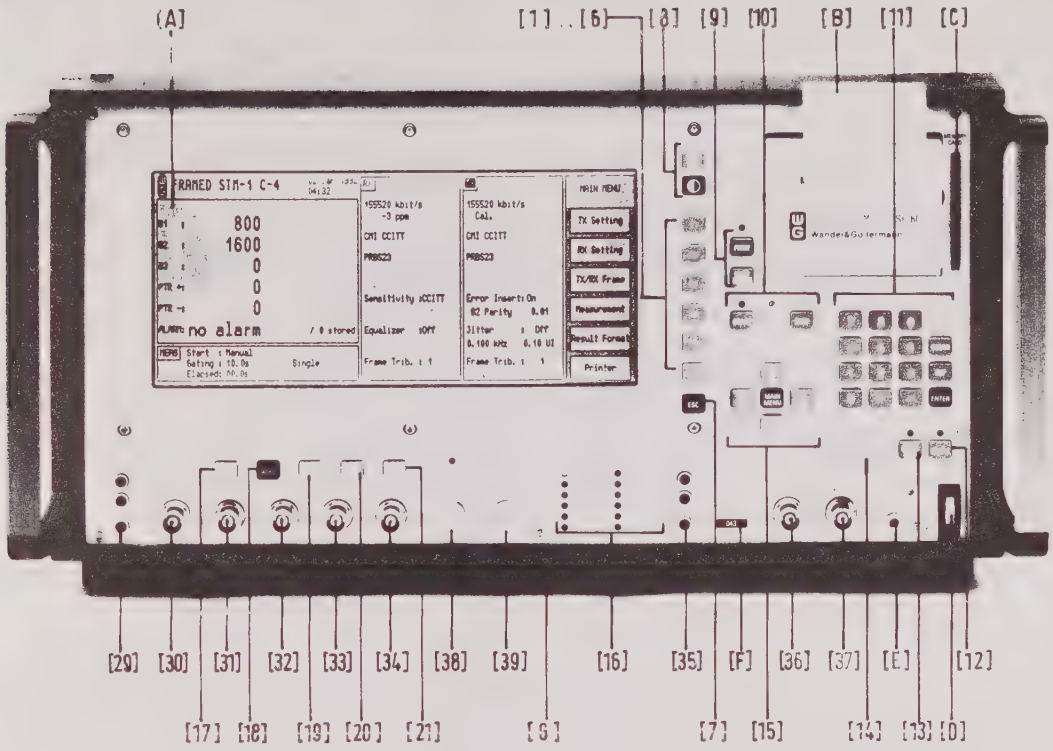


Fig. 3-1 SF-60 front view

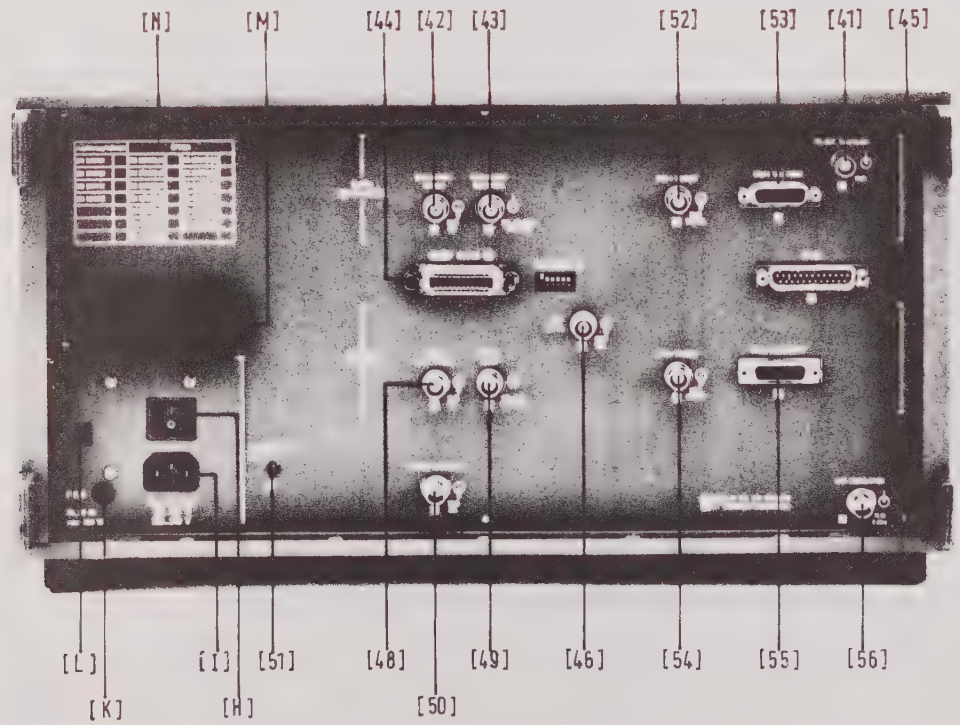


Fig. 3-2 SF-60 rear view

3 Manual operation

3.1 Operating principle

Operation of the SF-60 is application-oriented and menu-controlled.

The APPL key [18] located below the display should be used to initiate operation for any given measurement. It provides the quickest method of setting the instrument automatically for a desired application.

The six variable function keys (softkeys) F1 through F6 ([1] to [6]) are used to access the various menus and menu levels and to select the different parameter values. Numerical values can also be set using the number keypad and the rotary knob.

The 5 fixed function keys located below the display operate further instrument functions and provide information about the instrument.

Impermissible operating steps, such as those leading to an interruption of the measurement in progress or which would invalidate the result, and settings which are incompatible are either ignored by the instrument or indicated by means of error messages and warnings displayed on the screen.

3.1.1 Control elements (keys, displays, connectors)

All of the important control elements of the SF-60 are located on the front panel. Other connectors and the a.c. line switch are found on the back panel.

Figures 3-1 and 3-2 show the front and rear panel layout of the SF-60.

The numbers found in these two figures refer to the control elements given in the following listing of function descriptions. These identifying codes are shown in square brackets (e.g. [7], [A]) next to the pictograms of the controls.

3.1.1.1 Keys and LED displays

[1] to [6]

Six variable function keys, located to the right of the display.

Function in main menu (level 1): Access to the sub-menus indicated in the display fields next to the keys.

Function in sub-menus (level 2): Selection of parameters. The display fields indicate possible values for the parameter indicated by the black cursor marker.

Other functions: In Bit Pattern 1 - 4 mode the keys have the functions Cursor Right, Cursor Left and CLEAR (e.g. delete all bits).

If an entry can be made using the keypad or the rotary control (e.g. selecting the TX channel/ tributary) the fields for softkeys [1] and [2] will be marked with the message "Use 0...9 or knob".

[7]

Jump back one menu level.

If HELP or error texts are displayed, press ESC to clear the text from the screen.

[8]

Manual contrast control for LC display

[9]

Manual triggering of printout of results (including intermediate results), device settings, etc.

Yellow LED "AUTO" is lit when printer trigger set to automatic (main menu page [6] = Printer, Print Mode [1]) or if maximum tolerable jitter (MTJ) or G.821 measurements are selected (main menu page [4]: Measurement Menu)

[9]

Press during printout:	Stops printout and switches from automatic to manual print trigger mode (except during a measurement sequence).
Press when printer inactive:	Paper feed for printer. Press briefly for single line feed. Hold down for continuous line feed.

[10]

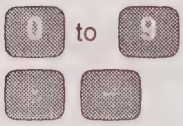
Press to start timer-controlled measurements. The relevant result memories are cleared when START is pressed.

The green LED indicates that the measurement is in progress.

The yellow LED "TIMER" indicates that the measurement is to be started and stopped by the timer. The START key is disabled (set timer mode in the measurement sub-menu).

[10]

Stops measurement in progress. Stopped status indicated by red LED.



[11]

Keypad for entering numerical values, decimal point and negative sign. Press ENTER to confirm value.

[11]

Confirms entries made with the number keypad (flashing display); i.e. values become effective only after ENTER has been pressed.

[11]

Enter an exponent value. Indicated by "E" in the display.

[11]

Deletes new entries which have not been confirmed (flashing display) one character at a time from the last character entered.

Exception: New entries of a bit pattern: When CLEAR is pressed after activating bit pattern entry, all bits of the bit pattern are deleted. The flashing bar indicates that entries can now be made; these become effective only after ENTER is pressed.

Further function: If CLEAR is pressed at the same time as the instrument is being switched on, the instrument is reset to default values; see section 3.2 "Getting started".

Warning: All stored data are erased by resetting to default values.

[12]

For switching from remote-control to manual operation and vice versa. Red LED "REMOTE" is lit when instrument in remote-control mode, off in manual mode.

If the LOCAL key is pressed during remote-controlled operation, the front panel controls are temporarily enabled for manual operation.

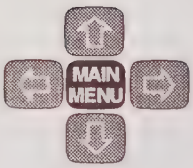
[13]

Disables the controls, indicated by the red LED. Press key again to enable controls.

[14] Rotary knob

For entering numerical values; turn clockwise to increase value, anticlockwise to decrease value.

Additional function: When selecting a digital word, octet or 2x8 bit word, the cursor position (bit displayed in inverse video) can be moved within the pattern to the left or right by turning the knob.



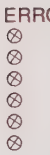
[15]

The arrow (cursor) keys move the black marker field within a menu page.

Pressing the MAIN MENU key returns you from any point to the main menu showing the six sub-menus in the softkey fields.

[16]

Red LEDs indicating alarms. The LEDs light up when the appropriate alarm is detected by the receiver.



[16]

Red LEDs indicating errors. The LEDs light up when the appropriate error state is detected by the receiver. The LED lights briefly or continuously, depending on the error ratio.

[17]

Calls up HELP texts. HELP texts are available for most of the parameters indicated by the black marker field on the main menu page and the sub-menu pages "TX Setting" and "RX Setting". The texts are displayed in a window on the left-hand side of the screen when the HELP key is pressed.

Press the ESC key to clear the text and enable the instrument for operation.

APPL

[18]

Calls up the Applications menu: menu page occupies the entire display area.

After an application has been selected, the main menu page appears showing the settings made automatically for the selected application. All previous settings are cleared, unless they were stored as a setup beforehand.

AUTO CONF

[19]

Calls up the Autoconfiguration menu

After pressing the START key in the Autoconfiguration menu, the RX signal is checked for bit rate, line code and pattern. Once the signal has been identified, the receiver and transmitter (if coupled) are set automatically to these signal parameters.

MEM

[20]

Calls up the Memory menu

This menu contains functions for storing setups internally or on the memory card, and for recalling, printing-out and copying stored setups, as well as starting measurement sequences, etc. and the result memory function.

TEST CONF

[21]

Calls up the Test & Configuration menu

This menu contains the self-test function (function check program), information and settings for the device configuration and device information. The stored date and time information can be set and menu language selected using this menu.

STANDBY ⊗

[D]

Standby switch (ON/OFF switch)

When the A.C. line switch [H] on the back panel is ON (position "I"):

Yellow LED "STANDBY" is lit when the instrument is switched off using the standby switch (ON/OFF switch indicator is black). Yellow LED is off when the instrument is switched on using the standby switch (ON/OFF switch indicator is red).

Other front panel elements

[A]	LC display
[B]	Thermal printer See section 2.7 "Printer" for details of how to fit new paper roll.
[C]	Slot for memory card
[F]	Serial number
[G]	Drawer for storing memory cards

3.1.1.2 Connectors

The following list gives details of the connectors on the front and back panels separately. The socket number is given on the left; the area of the panel in which the connector is located and a brief description of the function is given on the right.

Front panel

[29] GENERATOR [TX]
SIGNAL, 120 Ω
Balanced 2048 kbit/s signal output. (120 Ω)

[30] GENERATOR [TX]
SIGNAL 1
Signal output 1, 75 Ω

[31] GENERATOR [TX]
SIGNAL 2
Signal output 2, 75 Ω (option 2074/00.10)

[32] GENERATOR [TX]
SIGNAL 3
Signal output 3, 75 Ω (option 2074/00.10)

[33] GENERATOR [TX]
SIGNAL 4
Signal output 4, 75 Ω (option 2074/00.10)

[34] GENERATOR [TX]
CLOCK
Clock output 75 Ω

The modulated clock signal can be taken from this output when the jitter modulator (option) is switched on.

[35] RECEIVER [RX]
SIGNAL 120 Ω
Balanced 2048 kbit/s signal input (120 Ω)

[36] RECEIVER [RX]
SIGNAL 75 Ω
Signal input 75 Ω

[37] RECEIVER [RX]
CLOCK
Clock input 75 Ω

[38] OPTICAL INTERFACE TX (option BN 3017/00.02)
Optical transmitter
Output level at 155 520 kbit/s, NRZ, 2^{23}-1: typical: -8 dBm, min.: -12 dBm, max.: -5 dBm
Wavelength 1310 ± 50 nm, Class 1 laser device.

LED "LASER ON" is lit when the optical transmitter is on.

[39] OPTICAL INTERFACE RX (option BN 3017/00.02)
Optical receiver
Wavelength range: 1100 to 1570 nm
Sensitivity:
Input level at 155 520 kbit/s, NRZ, 2^{23}-1, 1310 nm:- 8 to -34 dBm

[E] Ground connector.

Back panel

[41] TX EXT. CLOCK
Input for external clock, 75 Ω
A.C. coupled, duty cycle 0.5

[42] GENERATOR [TX]
PATT / 2 Mbit/s HDB3
TRIGGER
- TX pattern trigger output, 75 Ω, ECL
- Input for 2 Mbit/s HDB3 (as tributary in the PDH chain or in the STM1 C12 signal)

The function is switched by selecting EXT 2 as the tributary for the TX side (from the "Frame Editor" application menu).

[43] GENERATOR [TX]
ERROR
RICAR FREQ
Control input for external error insertion (0 Hz to 10% of bit rate) or for toggling the Ricar sequence (max 0.02 x bit rate); level and input impedance switchable.

[44] IEEE 488 / IEC 625
IEEE bus interface, 24-way Amphenol connector. See section 4.1.1 for pin configuration.

[45] RS 232
V.24 interface, 25-way D connector. See section 4.2.2 for pin configuration.

[46] RECEIVER [RX]
CLOCK
Recovered clock output, 75 Ω, ECL.

[48] RECEIVER [RX]
EVENT TRIGGER
- Programmable event output, 75 Ω, ECL.
  (See section 3.3.4 “RX Setting” and “RX Setting” menu tree for event selections)
- Output 2 Mbit/s HDB3 (from the demultiplexer chain)

The function is switched by selecting "Trig Output [48]" in the RX menu.

[49] RECEIVER [RX]
ERROR
Input for external errors, switchable input impedance and sensitivity (ECL, TTL).

[50] TX REF CLOCK
Output for TX reference clock.

The output is active when the jitter modulator is switched on. The clock from this output serves as an unmodulated comparison clock for jitter modulated signals.

[51] CONNECT TO BCI-1
Power supply for BCI-1 Barcode Interface (+12 V).

[52] GENERATOR [TX]
STM-1 TRIGGER
Output
- for positive STM-1 trigger pulses or
- for 8 kHz signal; output impedance approx. 75 Ω, or
- Signal input for TX frame or multiframe synchronization to an external positive trigger pulse; input impedance 10 kΩ.

[53] GENERATOR [TX]
STM-1 V.11 INPUT
V.11 interface for inputting SOH/POH bytes. See section 8.4.1.3 for pin configuration.

[54] RECEIVER [RX]
STM-1 TRIGGER
Trigger output, output impedance approx. 75 Ω; one positive trigger pulse (50 ns) in last frame of multiframe cycle, or
Frame synchronization loss signal output; signal set high (OOF = out of frame), or
Synchronization output (8 kHz signal, for STM1-C12 additionally: 2048 kHz clock signal of multiframe).

[55] RECEIVER [RX]
STM-1 V.11 OUTPUT
V.11 interface for outputting SOH/POH bytes. See section 8.4.1.4 for pin configuration.

[56] EXT. MODULATION
Modulation input, 75 Ω, 0 dBm (option 2074/00.15)

Other elements on the back panel

[H] A.C. line switch: Position "**I**" = on, position "**O**" = off.

[I] A.C. line connector.

[K] Fuse holder, fuse type F 5 A, 50 to 60 Hz, max 330 VA.

[L] A.C. line voltage selector switch
Two ranges:
220 V: 220 to 240 V
110 V: 100 to 127 V

[M] Accessory box.

[N] Instrument order number and version.

3.1.2 Parameter entry principle

The following steps are required for entering a parameter:

- Use the variable function keys [1] through [6] or the fixed function keys to call up the menu or sub-menu containing the parameter to be set (refer to sections 3.1.3 "Menu structure, LC display format" and 3.1.4 "Menu trees")
- Use the cursor keys [15] to move the black marker field within a menu page on to the parameter to be set.

There are three methods of entering the new value:

1 Using the variable function keys [1] to [6] to enter preset values.
2 Using the number keypad [11] (flashing marker field indicates entry must be confirmed by pressing ENTER).
3 Using the rotary knob [14].

3.1.3 Menu structure, LC display format

The SF-60 menu is hierarchical in structure. The MAIN MENU is the first level; from here, the six sub-menus TX Setting, RX Setting, TX/RX Frame, Measurement, Result Format and Printer are invoked using the variable function keys [1] to [6]. Each of these sub-menus contains parameters which can be altered to suit the application. The locations of the various parameters in the menu tree are shown in sections 3.1.4 "Menu trees" and 3.3 "Manual operation" where the menus are described.

There are additional menus for Applications, Autoconfiguration, Memory (internal/external memory for setups and result memory) and Test & Configuration. These menus are invoked using the keys [18], [19], [20] and [21].

LC display format

Figure 3-3 (below) shows the format of the liquid-crystal display as illustrated by the main menu page after initialization (= Unframed Error Test, 139264 kbit/s).

The **left-hand half of the display** is the results page. The results of either the counters 1 - 3, the G.821 measurement or the results of the parity / pointer counter, the SOH / POH (for options BN 3017/00.03 + BN 3017/00.05), etc, are shown here in two columns, depending on the selection made in the "Result Format" menu (F5). The absolute error count is given in the left-hand column, the right-hand column shows the error rate. In addition, the current alarms (e.g. "No Alarm" are displayed below the results. The number of alarms stored up till this time during the measurement is shown next to the current alarms (e.g. "/2 Alarms").

The gate time, elapsed gate time and the number of measurement cycles (e.g. single) are shown in the **MEAS window** at the bottom of the screen.

The **right-hand half** shows the more important RX settings and TX settings in separate windows. The six fields indicating the functions of the variable function keys F1 to F6 are shown at the right-hand edge of the display. In the main menu and the first level of the Applications, Memory and Test & Configuration menus, these fields show the sub-menu titles. In the sub-menus, the fields show values for the parameter indicated by the black marker field.

Parameters to be changed or set are indicated by the black marker field which is moved using the cursor keys [15]. In figure 3-3, the field is located in the top left corner of the TX Setting window (marking TX).

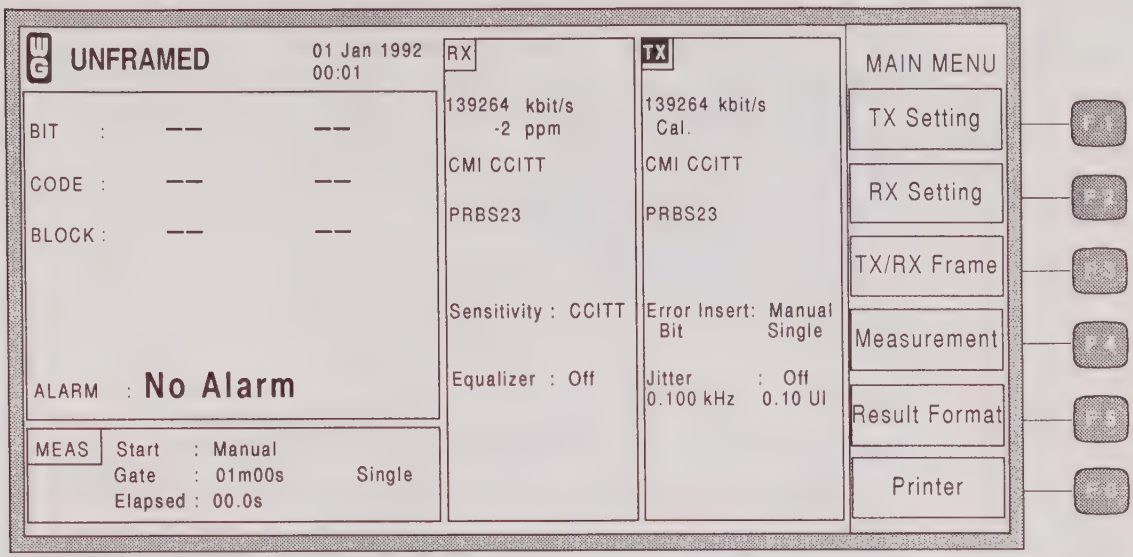


Fig. 3-3 Liquid-crystal display format (main menu).

3.1.4 Menu trees

The following pages show the hierarchical structure of the following menus:

- Applications [18]
- TX Setting (MAIN MENU, [F1])
- RX Setting (MAIN MENU, [F2])
- TX/RX Frame (MAIN MENU, [F3])
- Measurement (MAIN MENU, [F4])
- Result Format (MAIN MENU, [F5])
- Printer (MAIN MENU, [F6])
- Autoconfiguration [19]
- Memory [20] and
- Test/Configuration [21]

Explanation of menu tree structure

The title of the menu is shown at the top left in a box: **Applications**

The key which must be pressed to enter the menu is shown as a pictogram above the title.

The six variable function keys [1] to [6] and their corresponding selection fields are shown as pictograms at the top right of the pages showing the sub-menus to the MAIN MENU. The function key to be pressed in order to enter the menu shown (and the corresponding selection field) are labelled, the other keys and fields are shaded light grey.

In the menu tree, the first branch below the menu title (e.g. **TX Setting**) shows the parameters which appear in columns and rows in the display (e.g. **Bit Rate**). If a parameter is shown next to another, the cursor keys [15] or must be pressed to move the marker field from one parameter to the other.

The selection fields show preset values for the indicated parameter which can be selected using the variable function keys [1] to [6].

If parameters only appear in the menu for certain settings, such as Bit Rate, Line Code, Pattern, etc., this is indicated in the menu tree by an appropriate note next to the parameter or by a footnote.

If the menu pages for a given setting are very different for the various applications which can be selected, the menu is composed of several pages which show the menu with the alternative parameters. The application to which the menu shown applies is indicated as a heading above the menu tree: e.g. **PDH Exchange: 2 Mbit/s (64k/2)**.

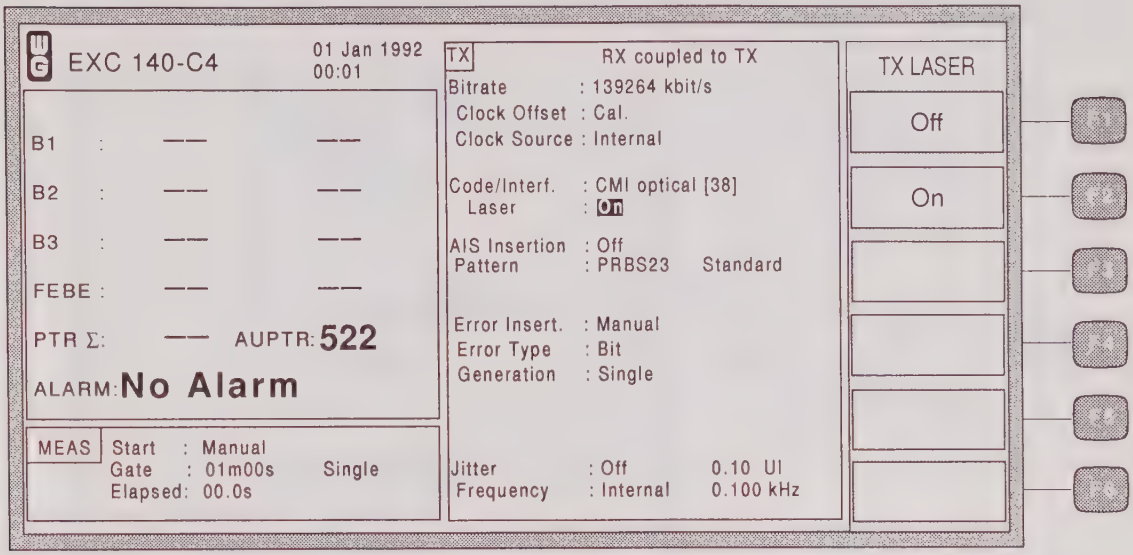
The labels in the diagrams of the menu tree correspond to the text seen in the SF-60 display, including all abbreviations. These abbreviations are explained in section 3.3 "Manual operation" under the descriptions of the individual menus.

Note: As the parameters available for selection and the functions of the variable function keys depend on the options fitted and on the application selected, the menu trees shown below indicate the selections available when all possible options are fitted (optical interface, PDH frames, SDH frame, jitter generator options, 2 Mbit/s Mapping, 34 Mbit/s Mapping and MUX chain).
If any of these options is not fitted to the SF-60 (e.g. no SDH frame option), the function keys will be labelled accordingly; any selections which are only possible when in connection with an option are not displayed unless the option is fitted. The function key labels are blank or are filled with other values.

Examples:

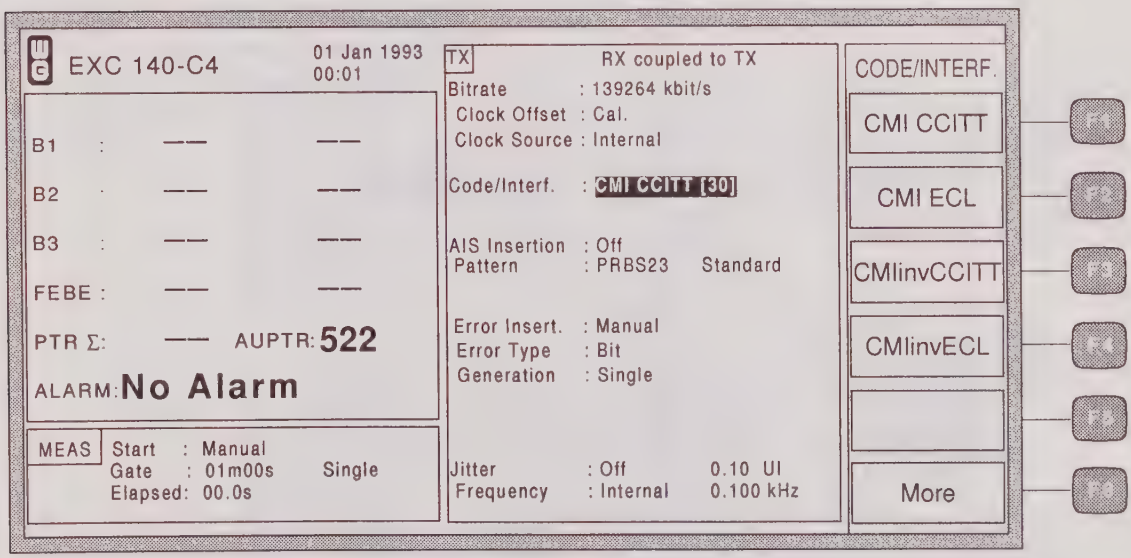
TX Setting menu

Example 1



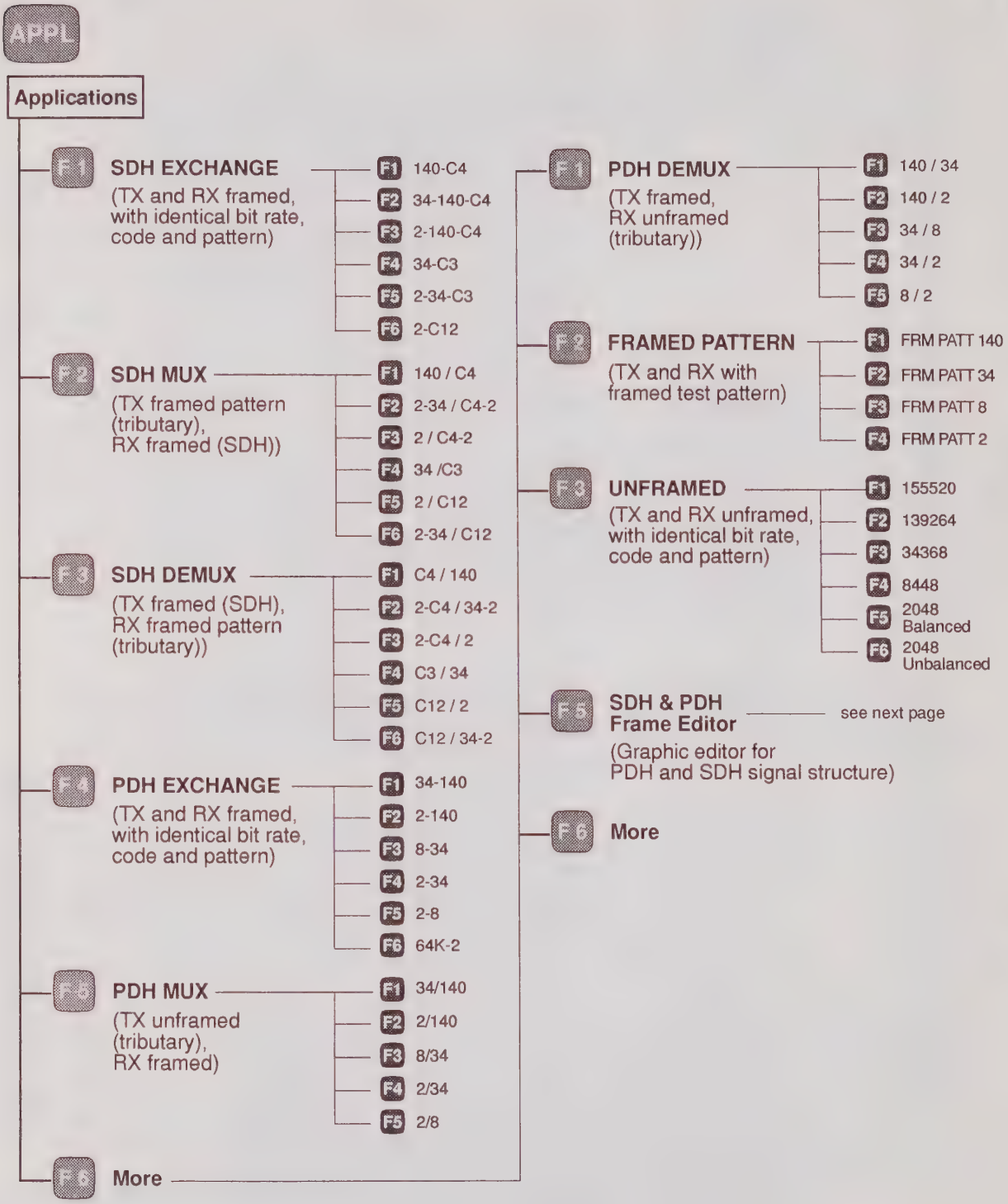
The parameter "Laser" only appears in the TX Setting menu if the optical interface option is fitted.

Example 2



As the "SDH Exchange 140-C4" application has been selected, the following line code parameter settings do not appear as function key labels in the TX Setting menu: CMI, TTL, NZR TTL, RZ TTL, HDB3, AMI and B3ZS. This is because these codes are only possible for bit rates of 2, 8 and 34 Mbit/s.

The selection "CMI optical" (shown in the first example) is not displayed either, if the optical interface is not fitted.


APPL
Applications
F1 SDH EXCHANGE
(TX and RX framed, with identical bit rate, code and pattern)
F1 140-C4
F2 34-140-C4
F3 2-140-C4
F4 34-C3
F5 2-34-C3
F6 2-C12
F2 SDH MUX
(TX framed pattern (tributary), RX framed (SDH))
F1 140 / C4
F2 2-34 / C4-2
F3 2 / C4-2
F4 34 /C3
F5 2 / C12
F6 2-34 / C12
F3 SDH DEMUX
(TX framed (SDH), RX framed pattern (tributary))
F1 C4 / 140
F2 2-C4 / 34-2
F3 2-C4 / 2
F4 C3 / 34
F5 C12 / 2
F6 C12 / 34-2
F4 PDH EXCHANGE
(TX and RX framed, with identical bit rate, code and pattern)
F1 34-140
F2 2-140
F3 8-34
F4 2-34
F5 2-8
F6 64K-2
F5 PDH MUX
(TX unframed (tributary), RX framed)
F1 34/140
F2 2/140
F3 8/34
F4 2/34
F5 2/8
F6 More
F1 PDH DEMUX
(TX framed, RX unframed (tributary))
F1 140 / 34
F2 140 / 2
F3 34 / 8
F4 34 / 2
F5 8 / 2
F2 FRAMED PATTERN
(TX and RX with framed test pattern)
F1 FRM PATT 140
F2 FRM PATT 34
F3 FRM PATT 8
F4 FRM PATT 2
F3 UNFRAMED
(TX and RX unframed, with identical bit rate, code and pattern)
F1 155520
F2 139264
F3 34368
F4 8448
F5 2048 Balanced
F6 2048 Unbalanced
F5 SDH & PDH Frame Editor
see next page
(Graphic editor for PDH and SDH signal structure)
F6 More

"SDH & PDH Frame Editor" selected in the "Applications" menu

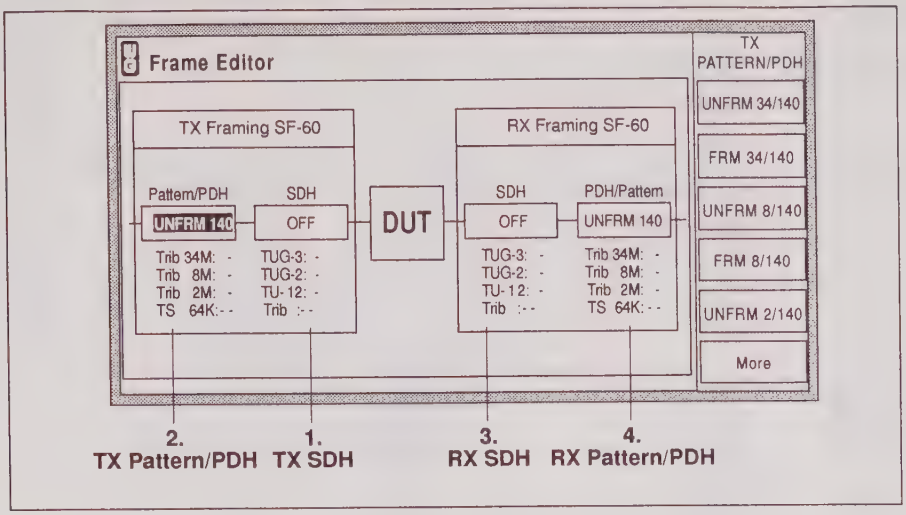
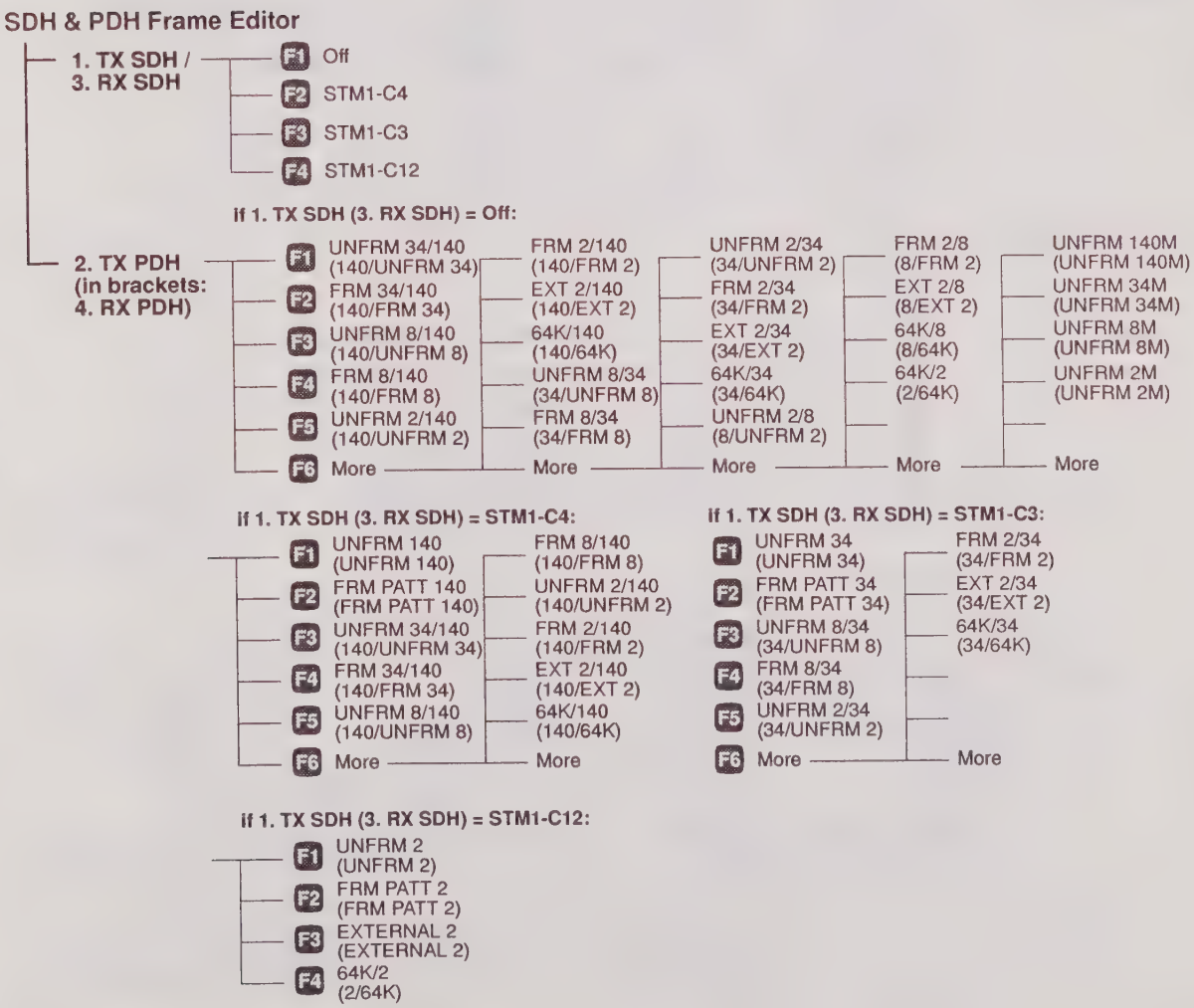
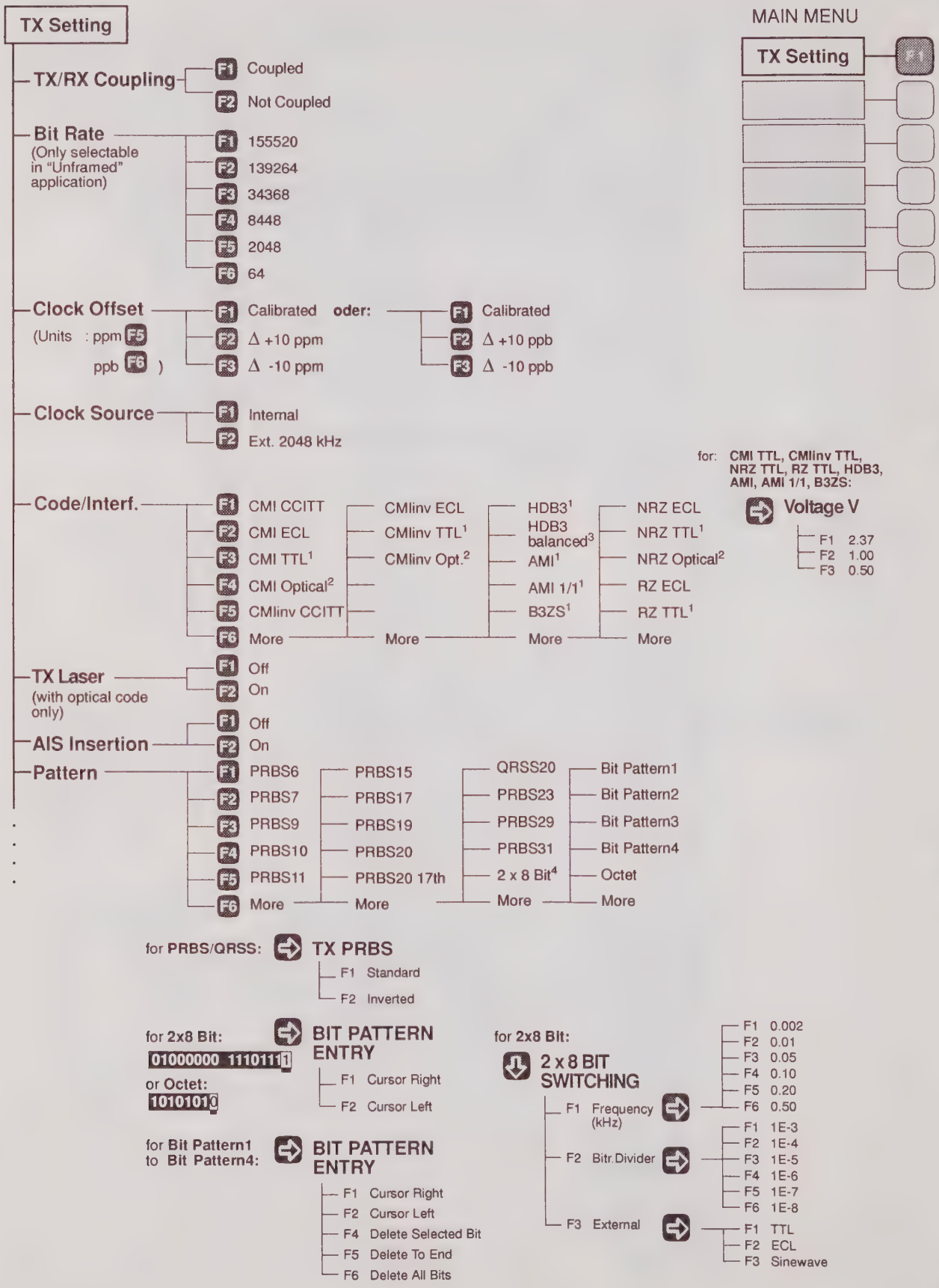
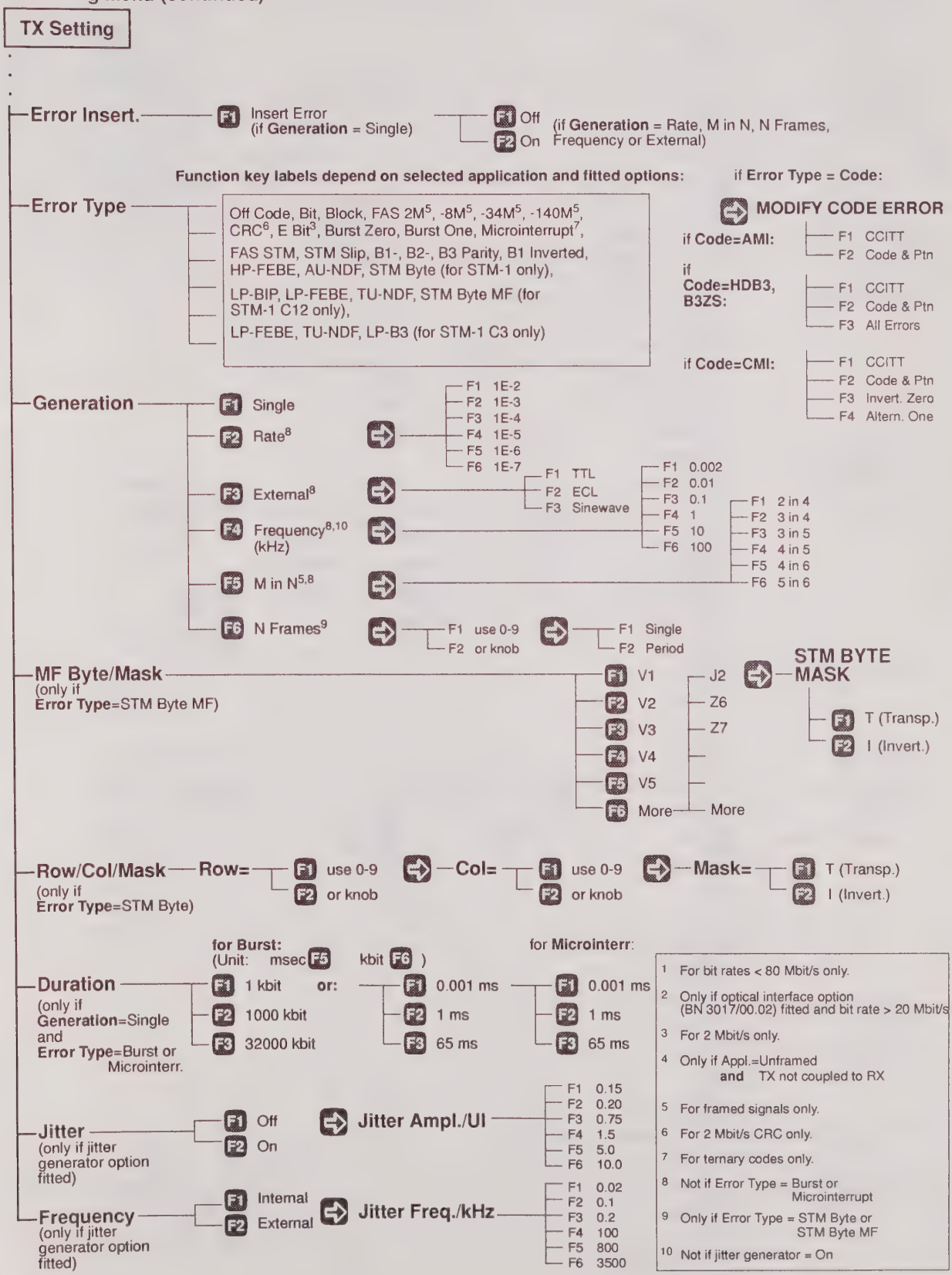


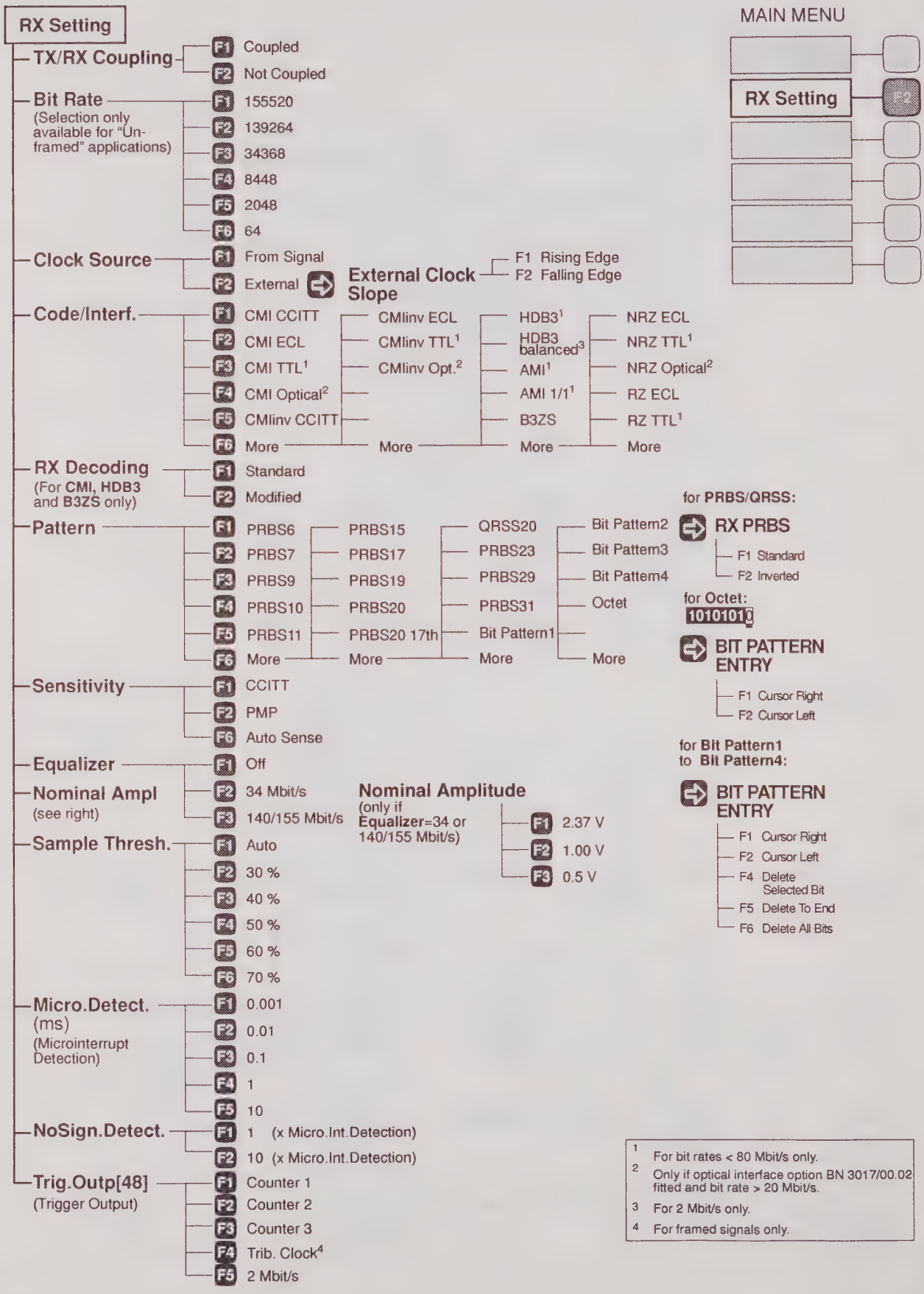
Fig. 3-4 Display after selecting "SDH & PDH Frame Editor" in the "Applications" menu


SDH & PDH Frame Editor
1. TX SDH / 3. RX SDH
F1 Off
F2 STM1-C4
F3 STM1-C3
F4 STM1-C12
If 1. TX SDH (3. RX SDH) = Off:
2. TX PDH (in brackets: 4. RX PDH)
F1 UNFRM 34/140 (140/UNFRM 34)
F2 FRM 34/140 (140/FRM 34)
F3 UNFRM 8/140 (140/UNFRM 8)
F4 FRM 8/140 (140/FRM 8)
F5 UNFRM 2/140 (140/UNFRM 2)
F6 More
FRM 2/140 (140/FRM 2)
EXT 2/140 (140/EXT 2)
64K/140 (140/64K)
UNFRM 8/34 (34/UNFRM 8)
FRM 8/34 (34/FRM 8)
More
UNFRM 2/34 (34/UNFRM 2)
FRM 2/34 (34/FRM 2)
EXT 2/34 (34/EXT 2)
64K/34 (34/64K)
UNFRM 2/8 (8/UNFRM 2)
More
FRM 2/8 (8/FRM 2)
EXT 2/8 (8/EXT 2)
64K/8 (8/64K)
64K/2 (2/64K)
More
UNFRM 140M (UNFRM 140M)
UNFRM 34M (UNFRM 34M)
UNFRM 8M (UNFRM 8M)
UNFRM 2M (UNFRM 2M)
More
If 1. TX SDH (3. RX SDH) = STM1-C4:
F1 UNFRM 140 (UNFRM 140)
F2 FRM PATT 140 (FRM PATT 140)
F3 UNFRM 34/140 (140/UNFRM 34)
F4 FRM 34/140 (140/FRM 34)
F5 UNFRM 8/140 (140/UNFRM 8)
F6 More
FRM 8/140 (140/FRM 8)
UNFRM 2/140 (140/UNFRM 2)
FRM 2/140 (140/FRM 2)
EXT 2/140 (140/EXT 2)
64K/140 (140/64K)
More
If 1. TX SDH (3. RX SDH) = STM1-C3:
F1 UNFRM 34 (UNFRM 34)
F2 FRM PATT 34 (FRM PATT 34)
F3 UNFRM 8/34 (34/UNFRM 8)
F4 FRM 8/34 (34/FRM 8)
F5 UNFRM 2/34 (34/UNFRM 2)
F6 More
FRM 2/34 (34/FRM 2)
EXT 2/34 (34/EXT 2)
64K/34 (34/64K)
More
If 1. TX SDH (3. RX SDH) = STM1-C12:
F1 UNFRM 2 (UNFRM 2)
F2 FRM PATT 2 (FRM PATT 2)
F3 EXTERNAL 2 (EXTERNAL 2)
F4 64K/2 (2/64K)

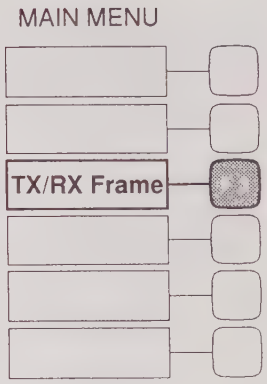

TX Setting
TX/RX Coupling
F1 Coupled
F2 Not Coupled
Bit Rate
(Only selectable in "Unframed" application)
F1 155520
F2 139264
F3 34368
F4 8448
F5 2048
F6 64
Clock Offset
(Units : ppm F5
ppb F6)
F1 Calibrated oder:
F2 Δ +10 ppm
F3 Δ -10 ppm
F1 Calibrated
F2 Δ +10 ppb
F3 Δ -10 ppb
Clock Source
F1 Internal
F2 Ext. 2048 kHz
Code/Interf.
F1 CMI CCITT
F2 CMI ECL
F3 CMI TTL1
F4 CMI Optical2
F5 CMIinv CCITT
F6 More
CMIinv ECL
CMIinv TTL1
CMIinv Opt.2
More
HDB31
HDB3 balanced3
AMI1
AMI 1/11
B3ZS1
More
NRZ ECL
NRZ TTL1
NRZ Optical2
RZ ECL
RZ TTL1
More
for: CMI TTL, CMIinv TTL, NRZ TTL, RZ TTL, HDB3, AMI, AMI 1/1, B3ZS:
Voltage V
F1 2.37
F2 1.00
F3 0.50
TX Laser
(with optical code only)
F1 Off
F2 On
AIS Insertion
F1 Off
F2 On
Pattern
F1 PRBS6
F2 PRBS7
F3 PRBS9
F4 PRBS10
F5 PRBS11
F6 More
PRBS15
PRBS17
PRBS19
PRBS20
PRBS20 17th
More
QRSS20
PRBS23
PRBS29
PRBS31
2 x 8 Bit4
More
Bit Pattern1
Bit Pattern2
Bit Pattern3
Bit Pattern4
Octet
More
for PRBS/QRSS:
TX PRBS
F1 Standard
F2 Inverted
for 2x8 Bit:
01000000 11101111
or Octet:
10101010
BIT PATTERN ENTRY
F1 Cursor Right
F2 Cursor Left
for Bit Pattern1 to Bit Pattern4:
BIT PATTERN ENTRY
F1 Cursor Right
F2 Cursor Left
F4 Delete Selected Bit
F5 Delete To End
F6 Delete All Bits
for 2x8 Bit:
2 x 8 BIT SWITCHING
F1 Frequency (kHz)
F1 0.002
F2 0.01
F3 0.05
F4 0.10
F5 0.20
F6 0.50
F2 Bitr.Divider
F1 1E-3
F2 1E-4
F3 1E-5
F4 1E-6
F5 1E-7
F6 1E-8
F3 External
F1 TTL
F2 ECL
F3 Sinewave
MAIN MENU
TX Setting F1

TX Setting Menu (continued)





1 For bit rates < 80 Mbit/s only.
2 Only if optical interface option BN 3017/00.02 fitted and bit rate > 20 Mbit/s.
3 For 2 Mbit/s only.
4 For framed signals only.



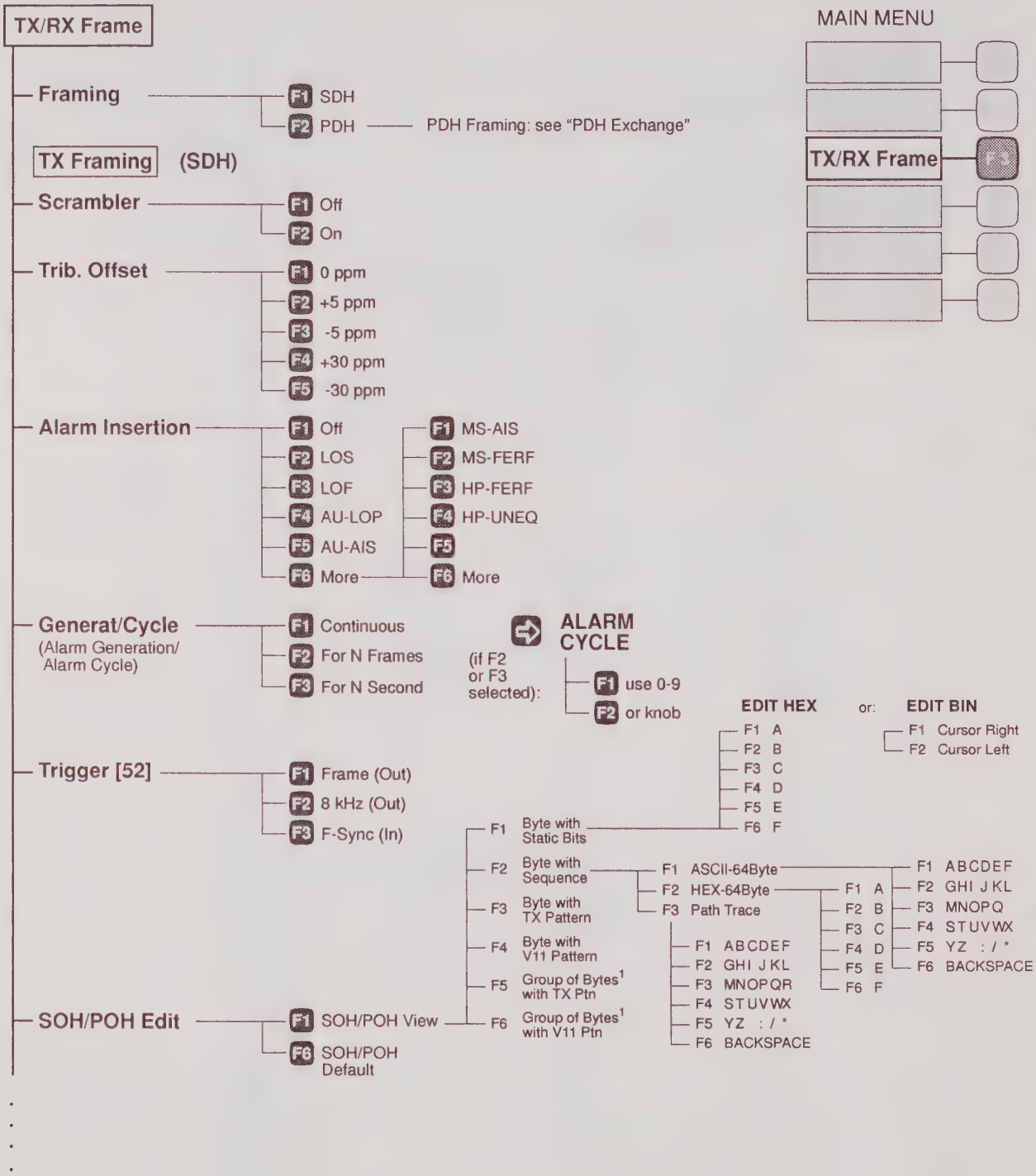
TX/RX FRAME

If **"UNFRAMED"** is selected (e.g. after resetting), the following message is displayed on the right-hand half of the screen:

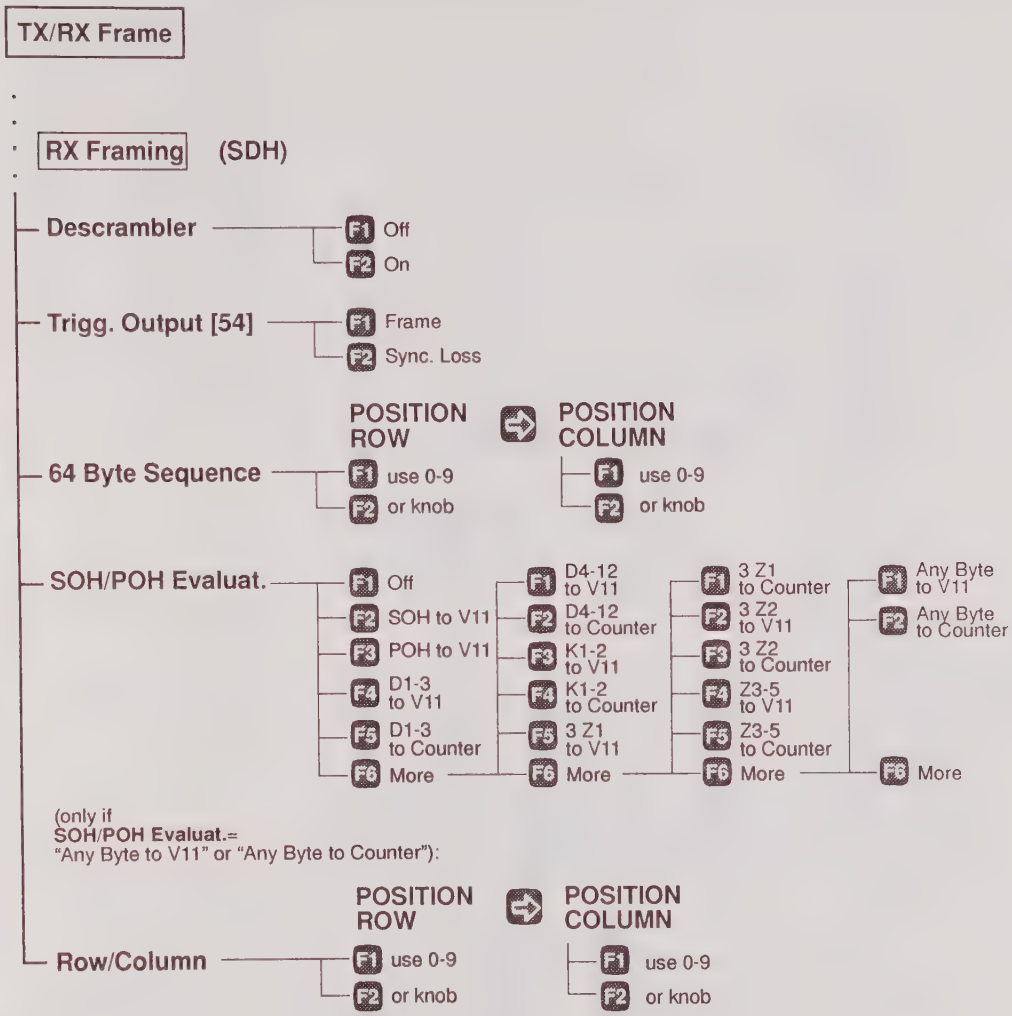
This Application is UNFRAMED
for FRAMED select 'APPL'

Note: 'APPL' = fixed function key

SDH EXCHANGE 140-C4 (Option BN 3017/00.05)

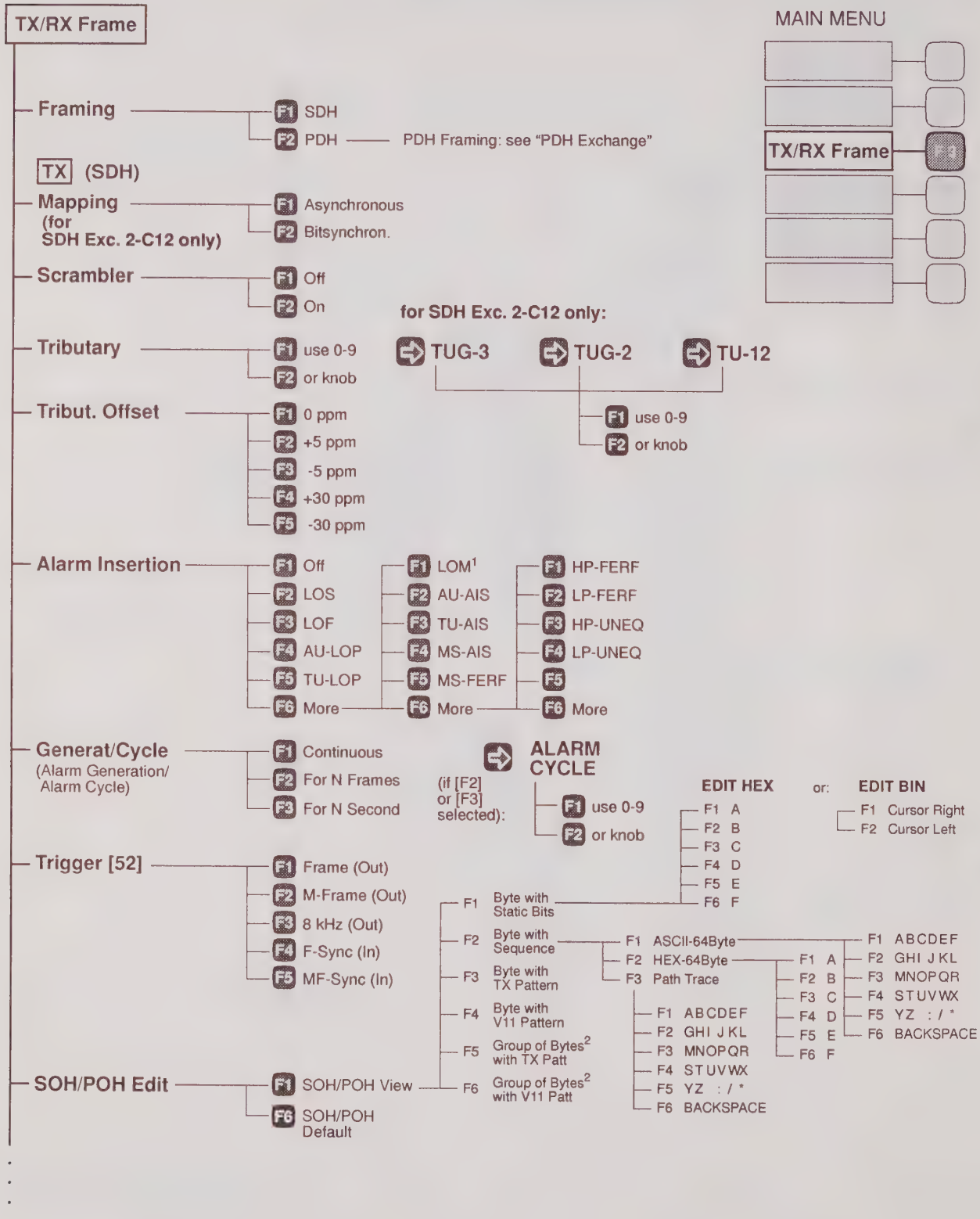


Menu "TX/RX Frame", SDH EXCHANGE 140-C4 (continued)

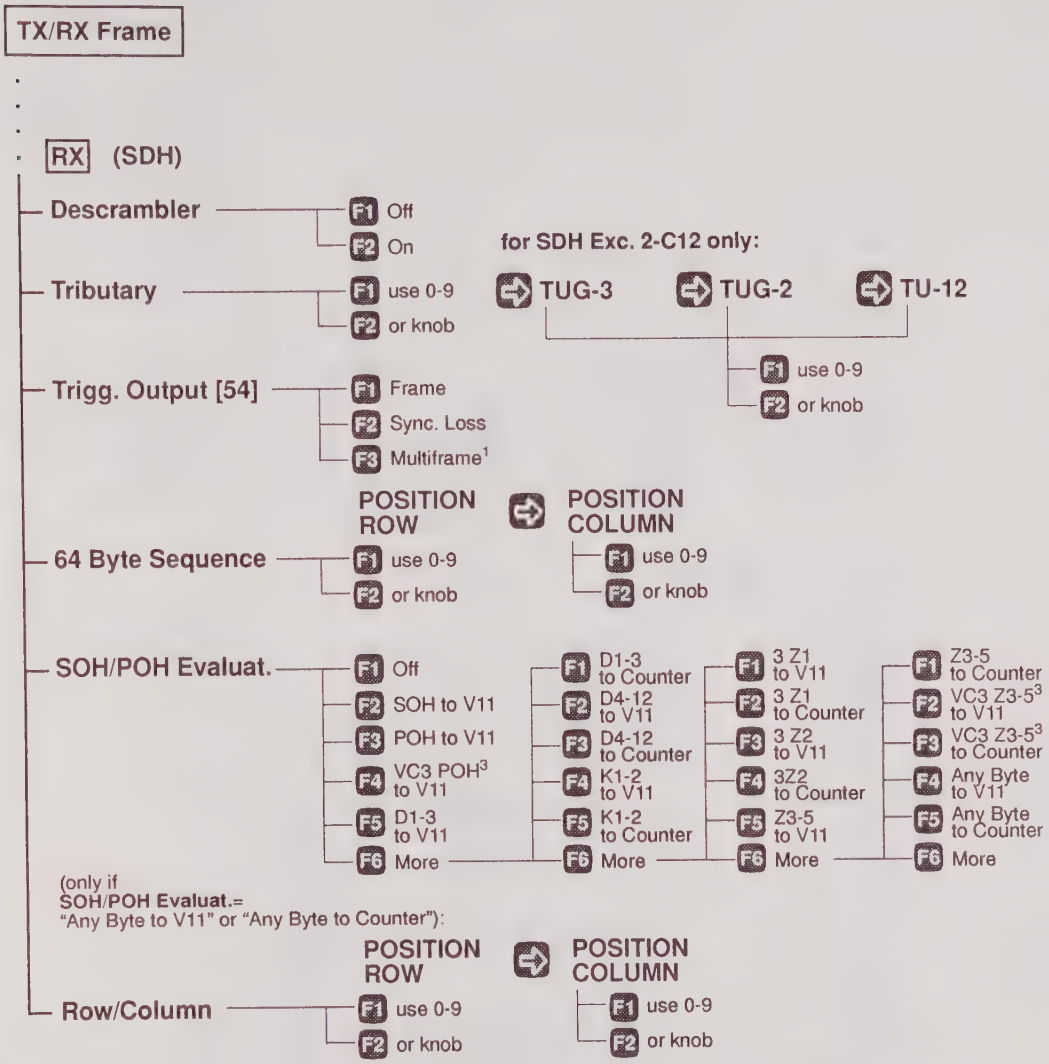


[1] only if cursor indicates D1-3, D4-12, K1-2, Z1, Z2 or Z3-5 in SOH/POH display.

SDH EXCHANGE (except SDH Exc. 140-C4)



Menu "TX/RX Frame, SDH Exchange" (continued)

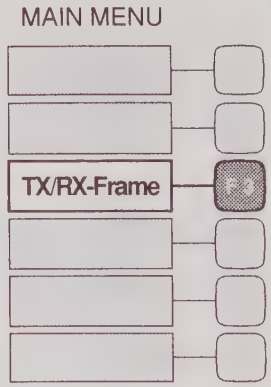


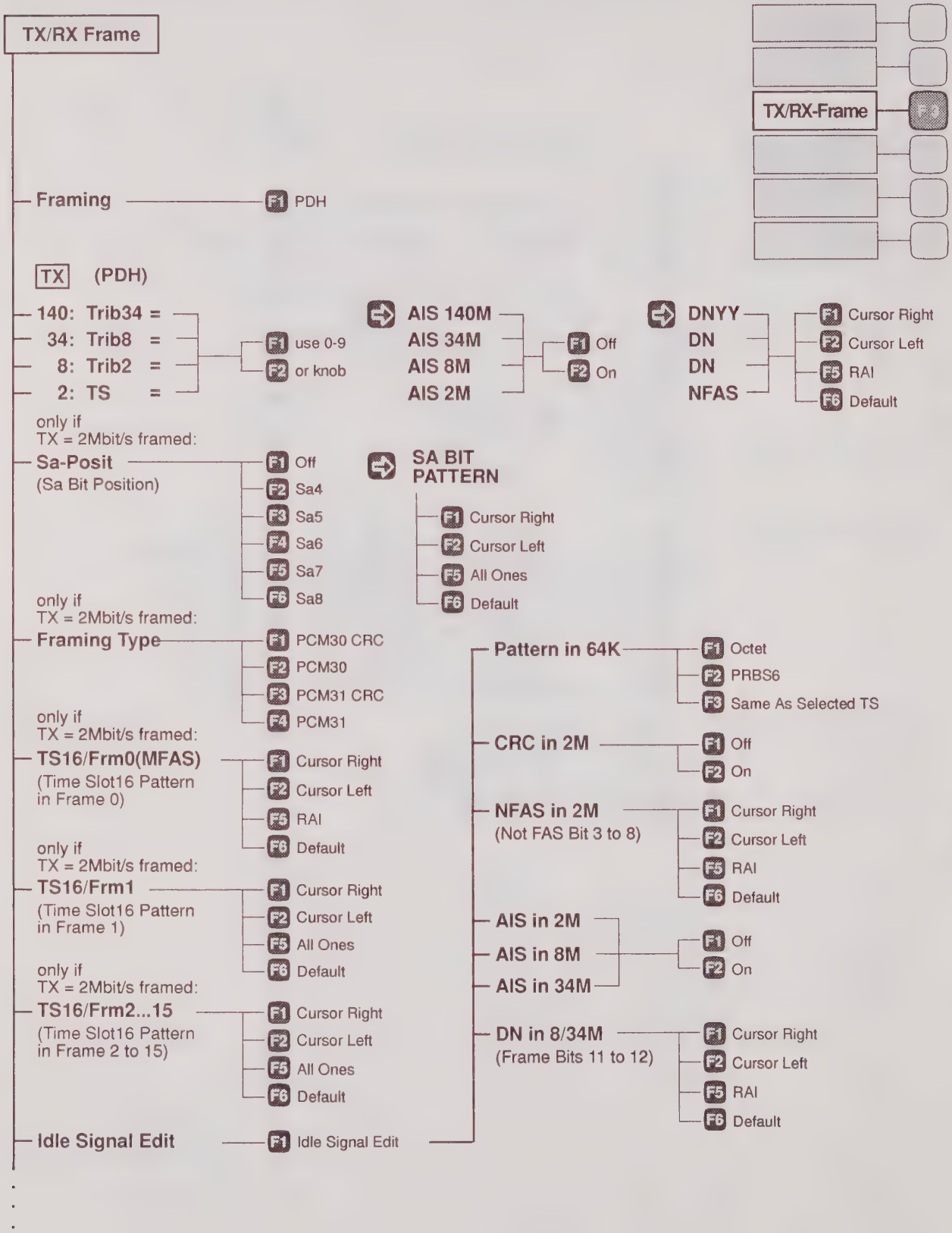
[1] for SDH Exc. 2-C12 only

[2] only if cursor indicates D1-3, D4-12, K1-2, Z1, Z2 or Z3-5 in SOH/POH display.

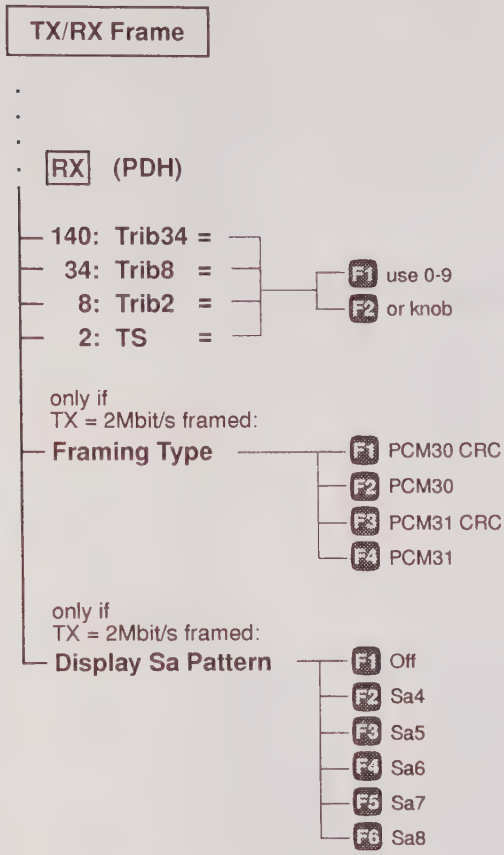
[3] for SDH Exc. 34-C3 only

PDH EXCHANGE:

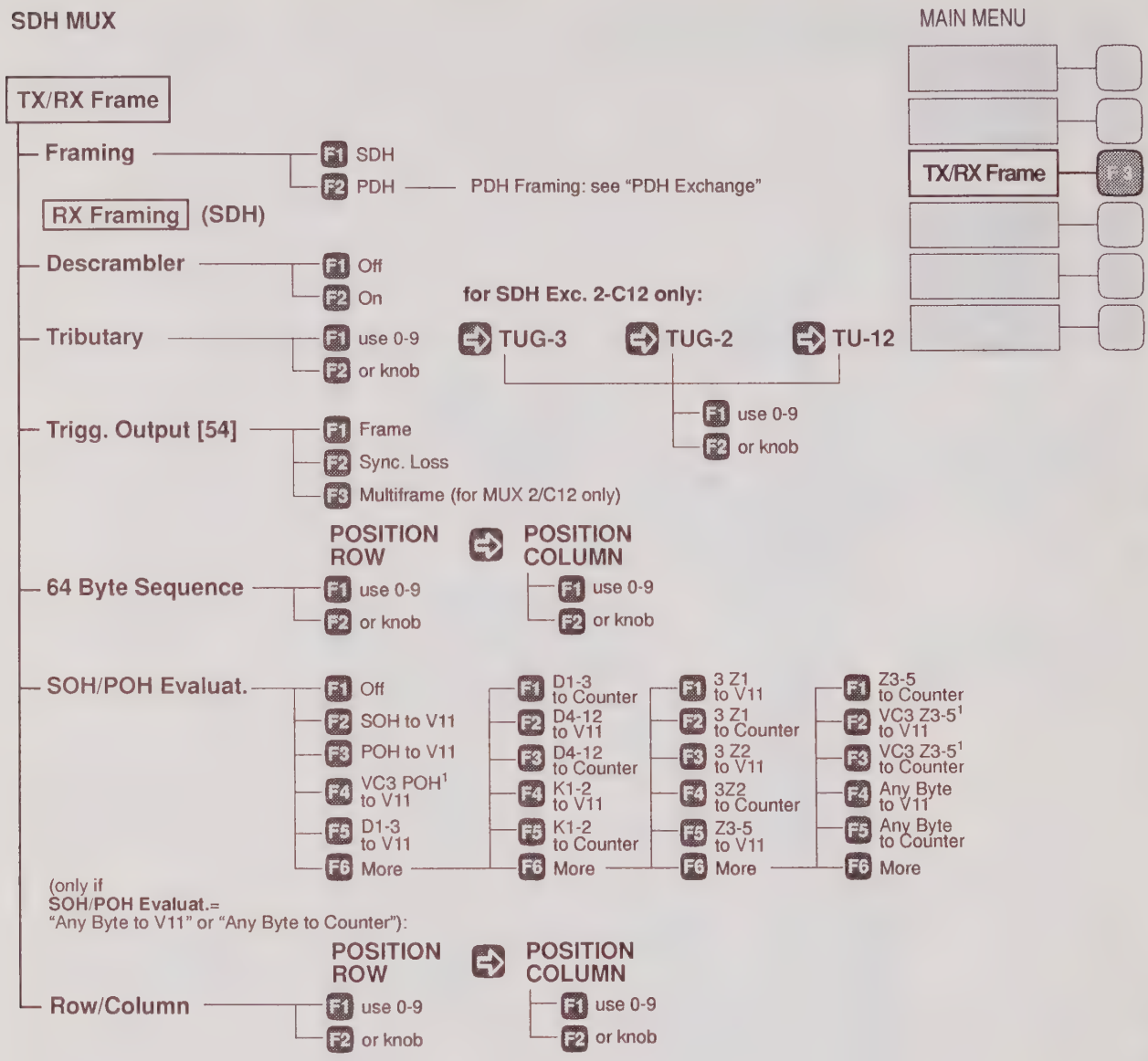




Menu "TX/RX Frame, PDH Exchange" (continued)



SDH MUX



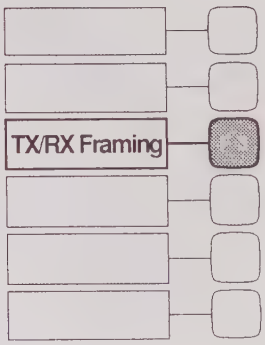
[1] for SDH MUX 34/C3 only

PDH MUX

TX/RX Frame

- Framing ——— F1 PDH —— PDH Framing: see "PDH Exchange"
- RX Framing (PDH)
- Menu same as for: PDH EXCHANGE, RX Framing

MAIN MENU

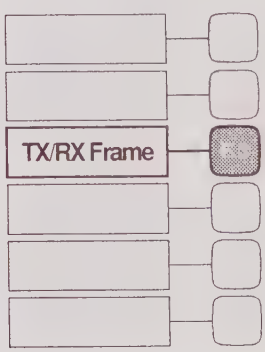


SDH DEMUX: C4/140

TX/RX Frame

- Framing ——— F1 PDH —— PDH Framing: see "PDH Exchange"
- TX Framing (SDH)
- Menu same as for : SDH EXCHANGE 140-C4, TX Framing

MAIN MENU

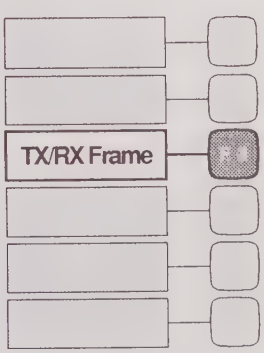


SDH DEMUX (except SDH DEMUX C4/140)

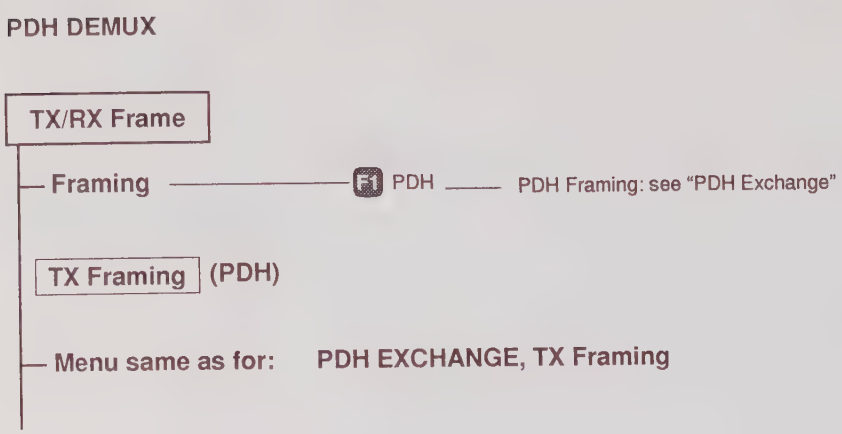
TX/RX Frame

- Framing ——— F1 PDH —— PDH Framing: see "PDH Exchange"
- TX Framing (SDH)
- Menu same as for: SDH EXCHANGE, TX Framing

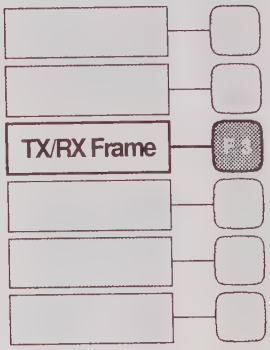
MAIN MENU

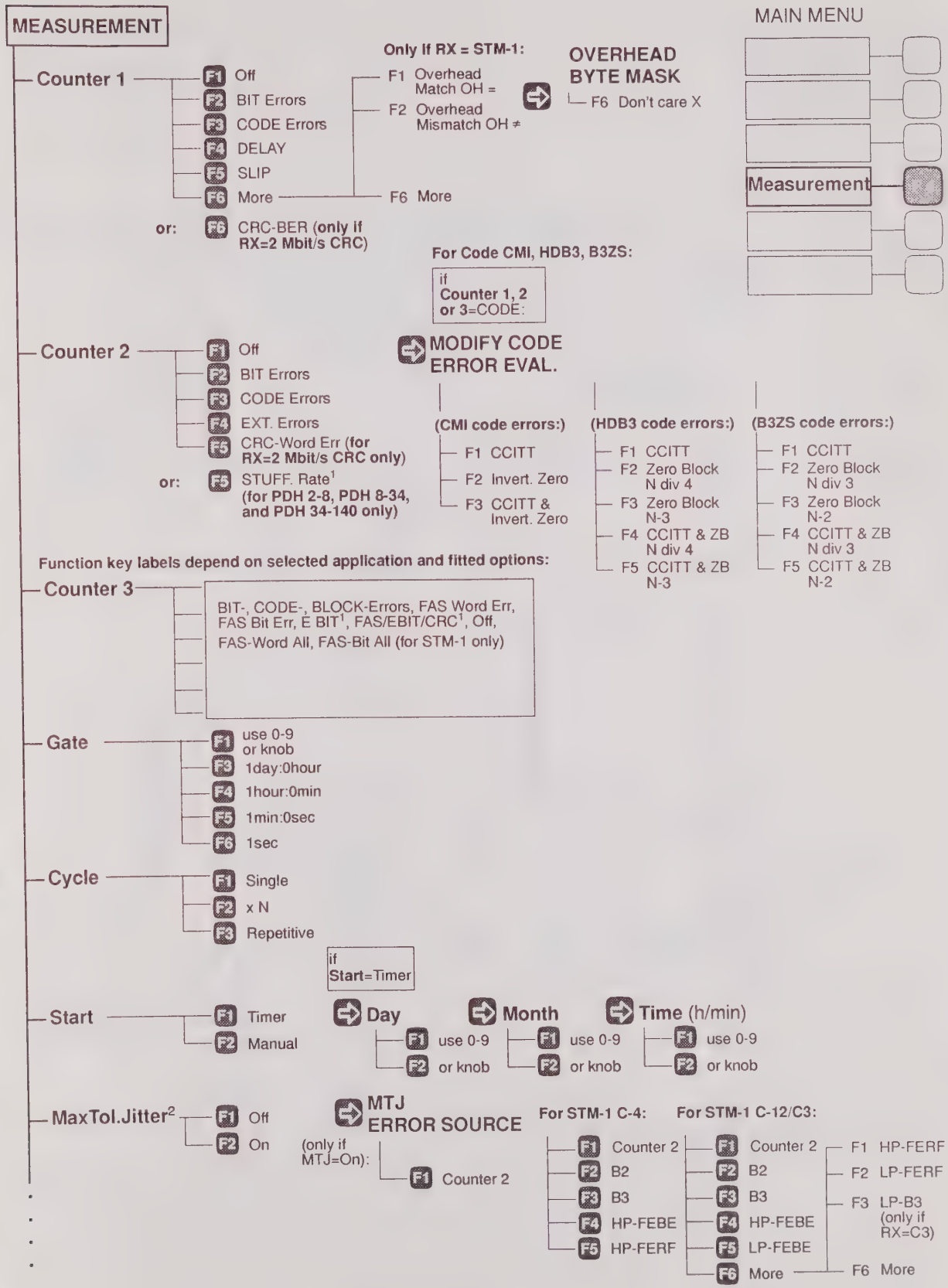


PDH DEMUX

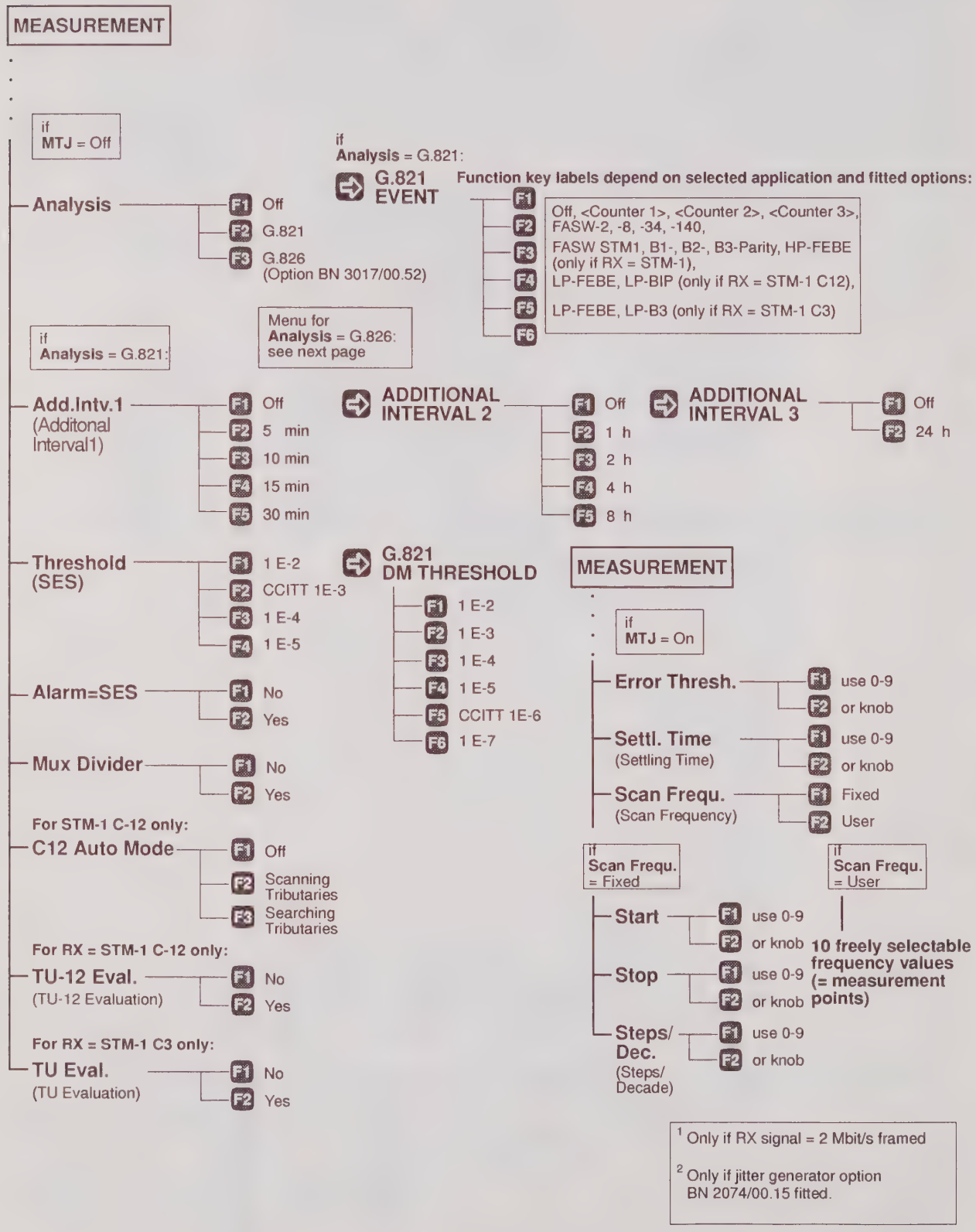


MAIN MENU




MEASUREMENT
MAIN MENU
Measurement
Counter 1
F1 Off
F2 BIT Errors
F3 CODE Errors
F4 DELAY
F5 SLIP
F6 More
Only if RX = STM-1:
F1 Overhead Match OH =
F2 Overhead Mismatch OH ≠
OVERHEAD BYTE MASK
F6 Don't care X
F6 More
or: F6 CRC-BER (only if RX=2 Mbit/s CRC)
For Code CMI, HDB3, B3ZS:
if Counter 1, 2 or 3=CODE:
MODIFY CODE ERROR EVAL.
Counter 2
F1 Off
F2 BIT Errors
F3 CODE Errors
F4 EXT. Errors
F5 CRC-Word Err (for RX=2 Mbit/s CRC only)
or: F5 STUFF. Rate1 (for PDH 2-8, PDH 8-34, and PDH 34-140 only)
(CMI code errors:)
F1 CCITT
F2 Invert. Zero
F3 CCITT & Invert. Zero
(HDB3 code errors:)
F1 CCITT
F2 Zero Block N div 4
F3 Zero Block N-3
F4 CCITT & ZB N div 4
F5 CCITT & ZB N-3
(B3ZS code errors:)
F1 CCITT
F2 Zero Block N div 3
F3 Zero Block N-2
F4 CCITT & ZB N div 3
F5 CCITT & ZB N-2
Function key labels depend on selected application and fitted options:
Counter 3
BIT-, CODE-, BLOCK-Errors, FAS Word Err, FAS Bit Err, E BIT1, FAS/EBIT/CRC1, Off, FAS-Word All, FAS-Bit All (for STM-1 only)
Gate
F1 use 0-9 or knob
F3 1day:0hour
F4 1hour:0min
F5 1min:0sec
F6 1sec
Cycle
F1 Single
F2 x N
F3 Repetitive
if Start=Timer
Start
F1 Timer
F2 Manual
Day
F1 use 0-9
F2 or knob
Month
F1 use 0-9
F2 or knob
Time (h/min)
F1 use 0-9
F2 or knob
MaxTol.Jitter2
F1 Off
F2 On
MTJ ERROR SOURCE
(only if MTJ=On):
F1 Counter 2
For STM-1 C-4:
F1 Counter 2
F2 B2
F3 B3
F4 HP-FEBE
F5 HP-FERF
For STM-1 C-12/C3:
F1 Counter 2
F2 B2
F3 B3
F4 HP-FEBE
F5 LP-FEBE
F6 More
F1 HP-FERF
F2 LP-FERF
F3 LP-B3 (only if RX=C3)
F6 More

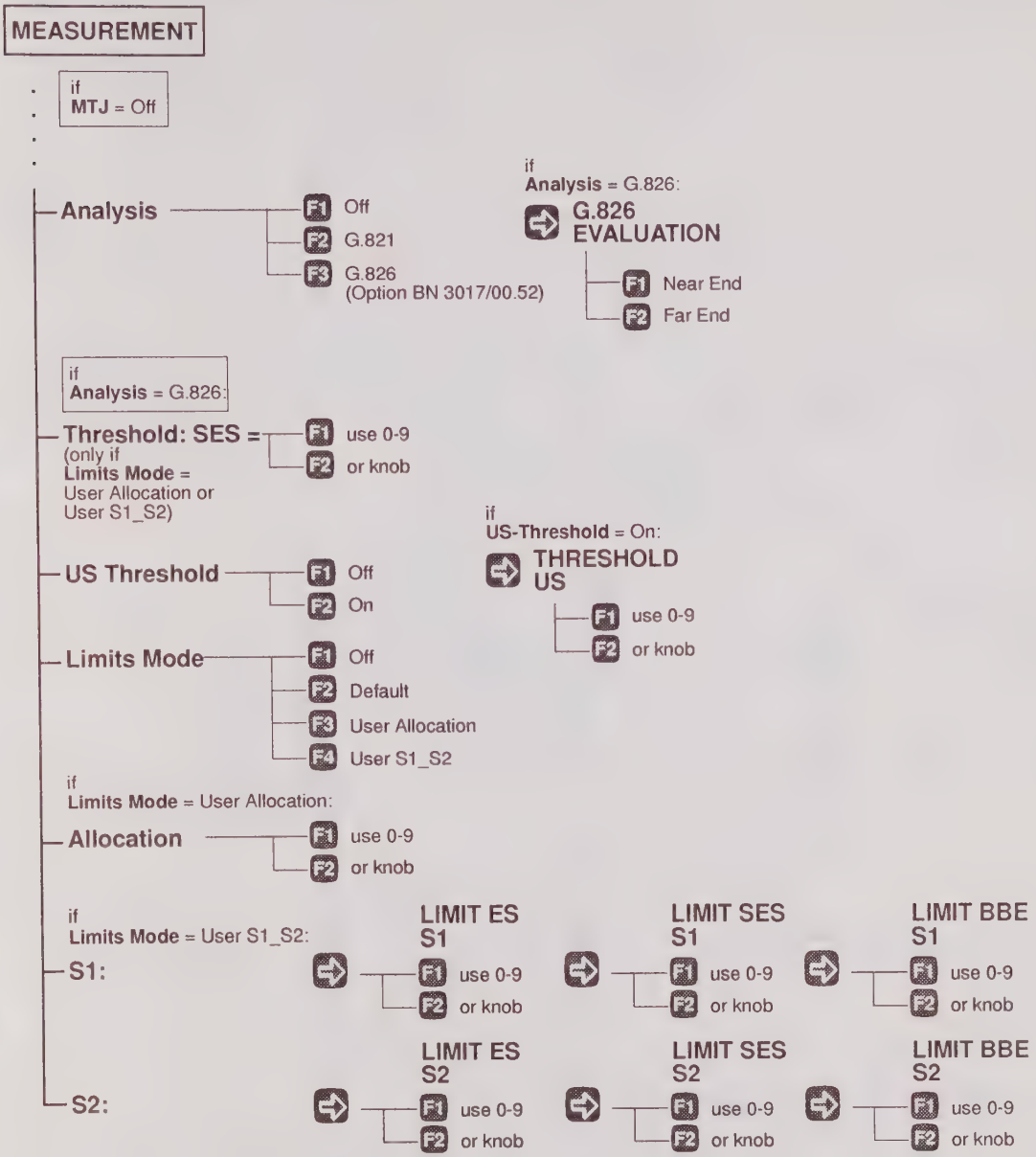
Menu "Measurement" (continued)

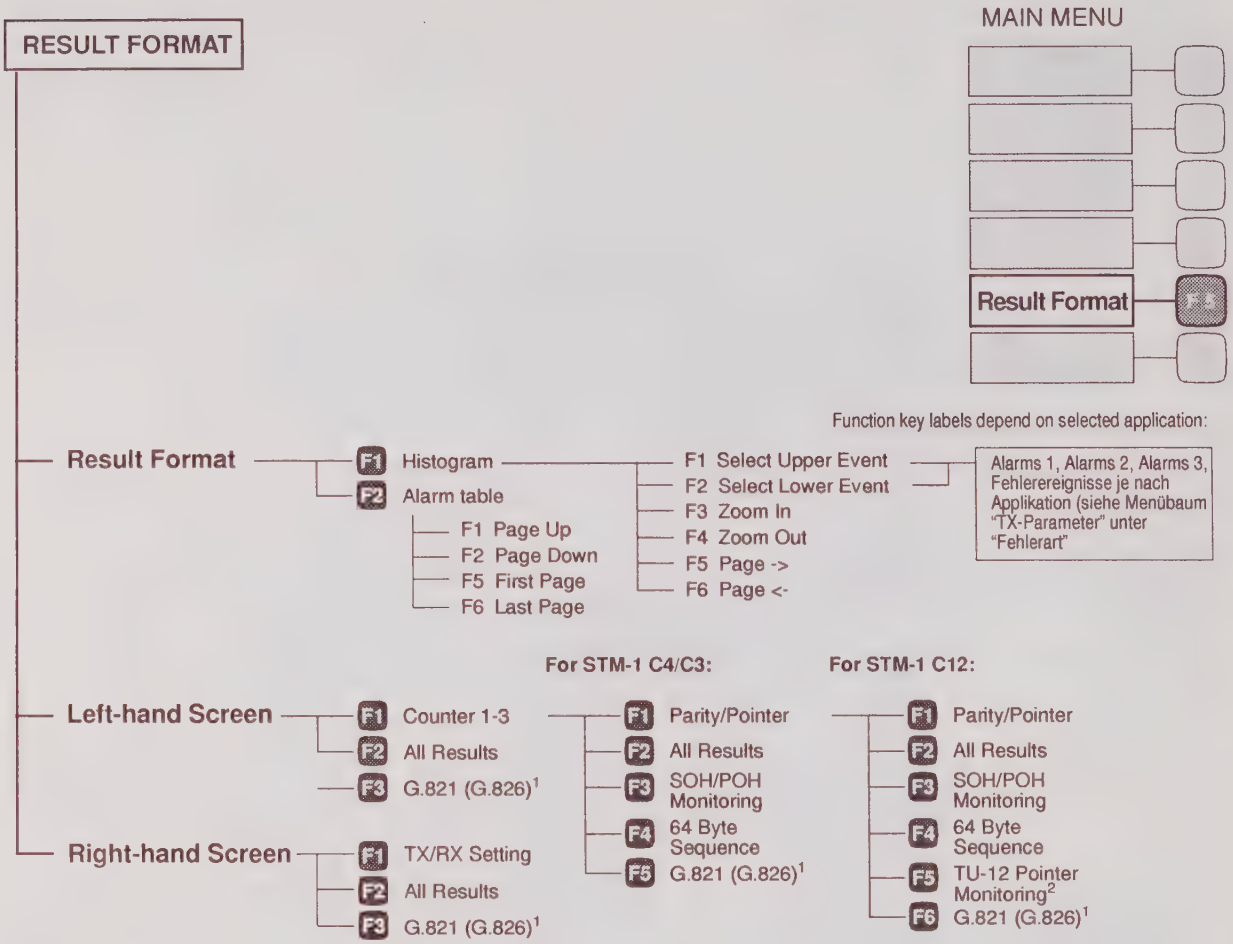


[1] Only if RX signal = 2 Mbit/s framed

[2] Only if jitter generator option BN 2074/00.15 fitted.

Menu "Measurement" (continued)

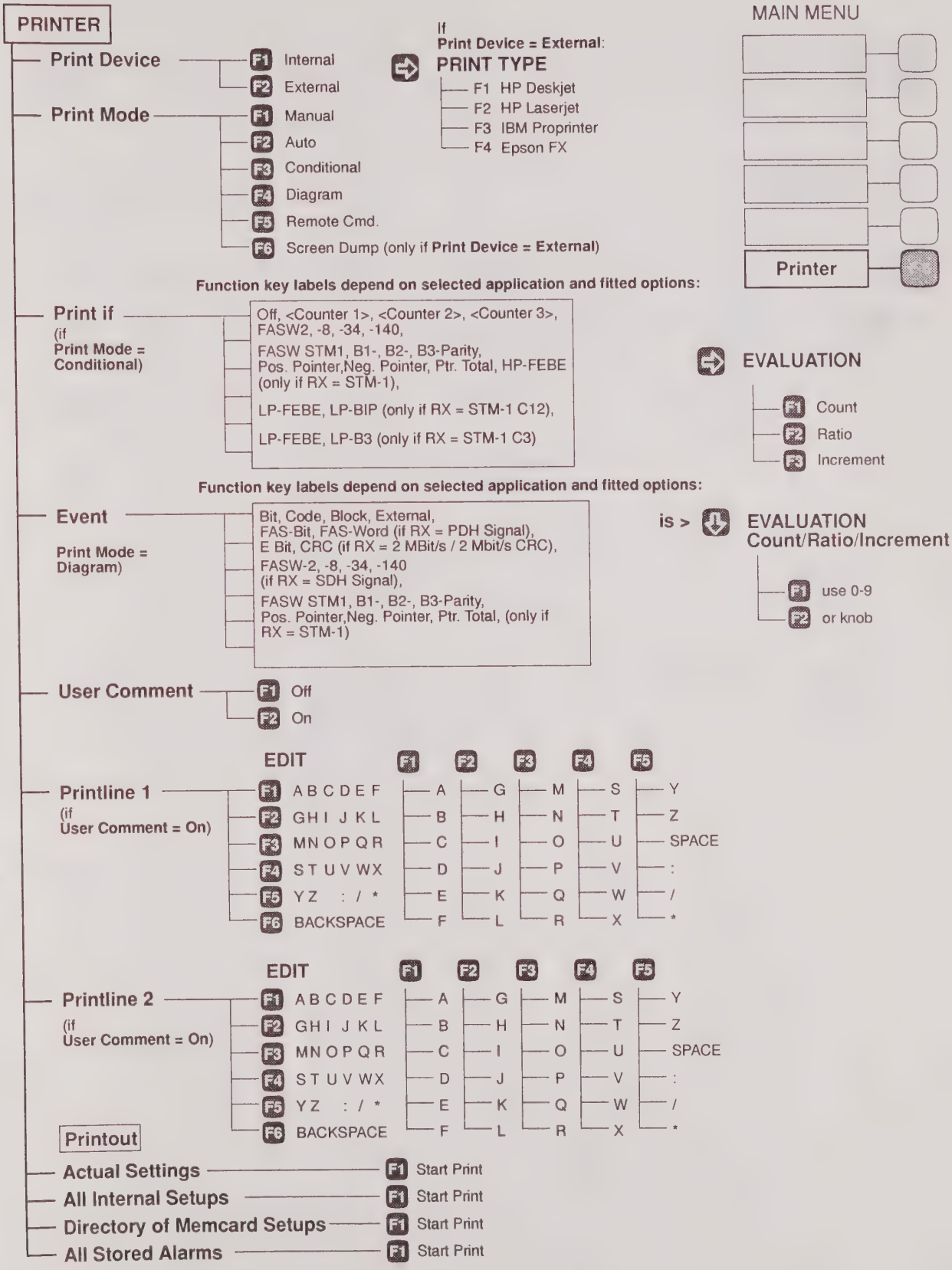




If "MaxTol.Jitter: On" is selected from the "Measurment" menu, the "RESULT FORMAT" menu is as follows:

[1] "G.821" or "G.826" only available for selection if "Analisis = G.821" or "G.826" selected from the "Measurement" menu.

[2] Only available for selection if "TU-12 Evaluation = On" selected from the "Measurement" menu.

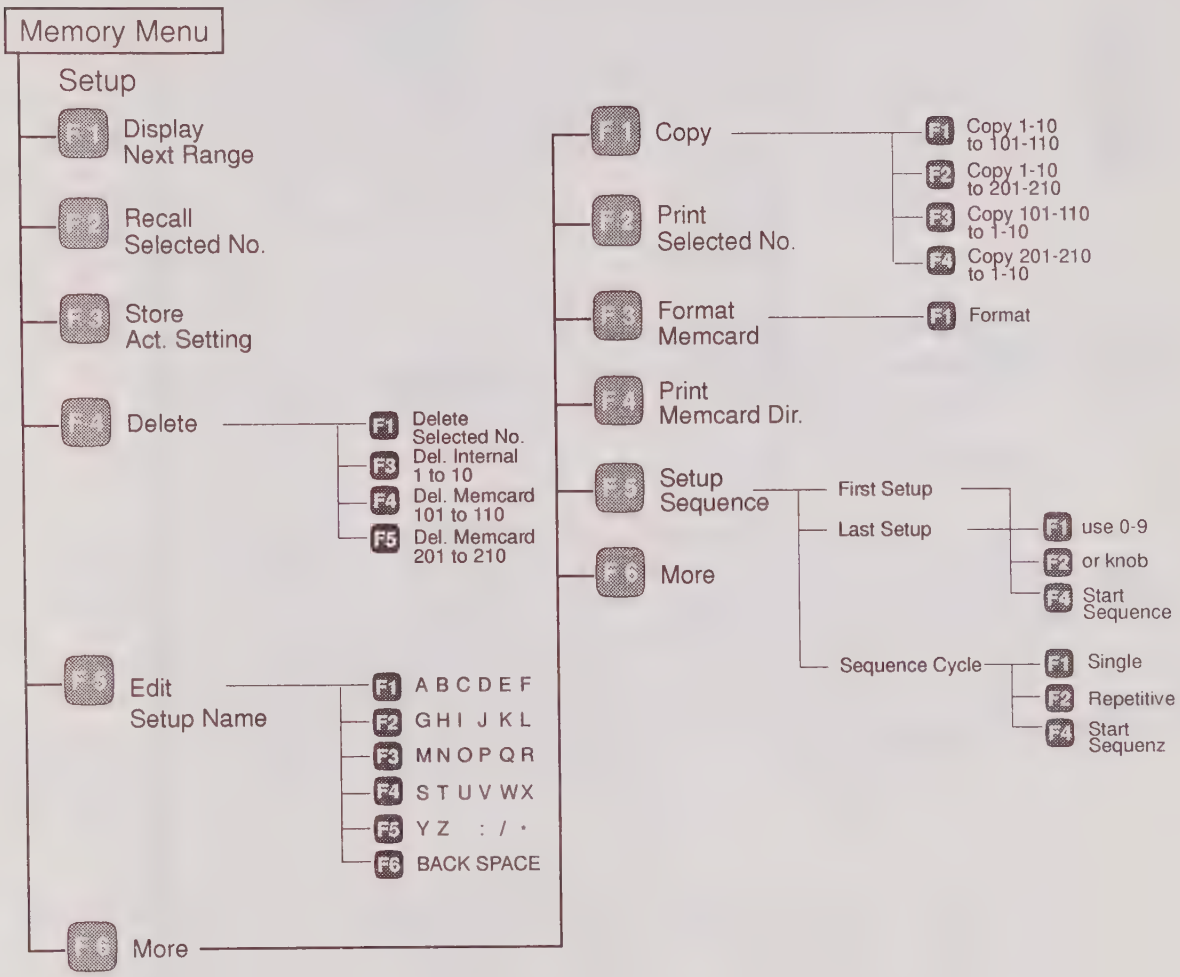

PRINTER
Print Device
F1 Internal
F2 External
Print Mode
F1 Manual
F2 Auto
F3 Conditional
F4 Diagram
F5 Remote Cmd.
F6 Screen Dump (only if Print Device = External)
If Print Device = External:
PRINT TYPE
F1 HP Deskjet
F2 HP Laserjet
F3 IBM Proprinter
F4 Epson FX
MAIN MENU
Printer
Function key labels depend on selected application and fitted options:
Print if
(if Print Mode = Conditional)
Off, <Counter 1>, <Counter 2>, <Counter 3>, FASW2, -8, -34, -140,
FASW STM1, B1-, B2-, B3-Parity, Pos. Pointer,Neg. Pointer, Ptr. Total, HP-FEBE (only if RX = STM-1),
LP-FEBE, LP-BIP (only if RX = STM-1 C12),
LP-FEBE, LP-B3 (only if RX = STM-1 C3)
EVALUATION
F1 Count
F2 Ratio
F3 Increment
Function key labels depend on selected application and fitted options:
Event
Print Mode = Diagram)
Bit, Code, Block, External, FAS-Bit, FAS-Word (if RX = PDH Signal), E Bit, CRC (if RX = 2 MBit/s / 2 Mbit/s CRC), FASW-2, -8, -34, -140 (if RX = SDH Signal), FASW STM1, B1-, B2-, B3-Parity, Pos. Pointer,Neg. Pointer, Ptr. Total, (only if RX = STM-1)
is >
EVALUATION Count/Ratio/Increment
F1 use 0-9
F2 or knob
User Comment
F1 Off
F2 On
EDIT
Printline 1
(if User Comment = On)
F1 A B C D E F
F2 G H I J K L
F3 M N O P Q R
F4 S T U V W X
F5 Y Z : / *
F6 BACKSPACE
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z SPACE : / *
EDIT
Printline 2
(if User Comment = On)
F1 A B C D E F
F2 G H I J K L
F3 M N O P Q R
F4 S T U V W X
F5 Y Z : / *
F6 BACKSPACE
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z SPACE : / *
Printout
Actual Settings F1 Start Print
All Internal Setups F1 Start Print
Directory of Memcard Setups F1 Start Print
All Stored Alarms F1 Start Print

AUTO CONF

Autoconfiguration

- F1 **Start**
- F6 **Restore old Application** (appears after pressing F1)

MEM


Memory Menu
Setup
F1 Display Next Range
F2 Recall Selected No.
F3 Store Act. Setting
F4 Delete
F1 Delete Selected No.
F3 Del. Internal 1 to 10
F4 Del. Memcard 101 to 110
F5 Del. Memcard 201 to 210
F5 Edit Setup Name
F1 A B C D E F
F2 G H I J K L
F3 M N O P Q R
F4 S T U V W X
F5 Y Z : / •
F6 BACK SPACE
F6 More
F1 Copy
F1 Copy 1-10 to 101-110
F2 Copy 1-10 to 201-210
F3 Copy 101-110 to 1-10
F4 Copy 201-210 to 1-10
F2 Print Selected No.
F3 Format Memcard
F1 Format
F4 Print Memcard Dir.
F5 Setup Sequence
First Setup
Last Setup
F1 use 0-9
F2 or knob
F4 Start Sequence
Sequence Cycle
F1 Single
F2 Repetitive
F4 Start Sequenz
F6 More

TEST/ CONF

Test & Configuration

- F1 Config.
  - Mode
    - F1 Modem
    - F2 PC
    - F3 Printer
  - Baud Rate
    - F1 300
    - F2 1200
    - F3 2400
    - F4 4800
    - F5 9600
  - Data Bits
    - F1 7
    - F2 8
  - Stop Bits
    - F1 1
    - F2 2
  - Parity
    - F1 None
    - F2 Even
    - F3 Odd
  - Handshake
    - F1 Xon/Xoff
    - F2 RTS/CTS
  - Modem Password
    - F1 A B C D E F
    - F2 G H I J K L
    - F3 M N O P Q R
    - F4 S T U V W X
    - F5 Y Z : / ·
    - F6 BACK SPACE
  - Date & Time
    - Date
      - F1 use 0-9
      - F2 or knob
    - Time
      - F1 use 0-9
      - F2 or knob
    - Beeper
      - F1 Off
      - F2 Warning
      - F3 Event & Warn
    - Language
      - F1 English
      - F2 German (etc.)
    - Backlight Level
      - F1 100 %
      - F2 70 %
      - F3 50 %
- F2 Self Test
  - Self Test
    - F1 All
    - F2 Single
    - F4 Start Test
  - Self Test Number (only if **Self Test**="Single")
    - F1 use 0-9
    - F2 or knob
    - F4 Start Test
  - Self Test Cycle
    - F1 Single
    - F2 Repetitive
    - F4 Start Test
- F3 SF-60 Info
  (Display of device data such as serial no., options, IEEE bus address, software version)
- F6 Service
  (For service engineers only!)

3.2 Getting started (connect up, switch on, select application, measure)

This section gives a short explanation of the basic operating procedures for the SF-60. Most of the instrument functions are self-explanatory, so that reading this section will be sufficient familiarization with the SF-60 to allow practical measurements to be made.

Before using the SF-60, the following conditions must be fulfilled:

- The instrument must not show signs of any damage which might affect safety performance.
- It must not be switched on if condensation is present.
- The a.c. line voltage and frequency must correspond to the values set on the instrument (selection switch [L] on the back panel).
- The ground conductor must be connected correctly.

To start using the SF-60

1 Connect up

Connect the a.c. line connector [H] on the back panel to the a.c. line supply using the line cord.

Connect the signal output [30] to the signal input [36] using a screened coaxial cable. If the optical interface option BN 3017/00.01 is fitted, special cables and adapters are used to connect the signal output [38] and signal input [39]; see sections 8.5 and 8.11.7.

2 Switch on

Switch the a.c. line switch [K] on the back panel to the "I" position (on).

If the yellow LED "STANDBY" on the front panel lights up, the SF-60 is in standby mode (off) and the on/off switch [D] indicator panel is black.

Press the on/off switch to the on position (panel shows red and the yellow LED goes out).

The SF-60 now performs a self test routine which lasts about 10 seconds. The results of the test are shown on the display (figure 3-5). Once all the tests have been confirmed as o.k., the main menu page (figure 3-16) will be displayed along with the settings which were in force at the time the instrument was last switched off.

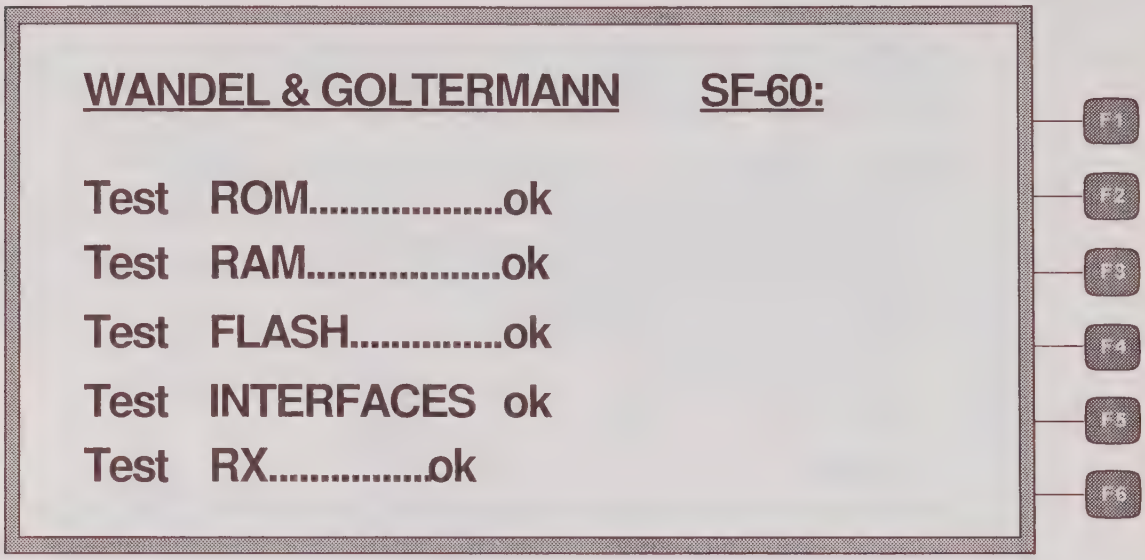


Fig. 3-5 Display after successful self-test

If an error message is displayed and a beep is heard when the self-test is run, switch the instrument off and perform **initialization** as follows:

Press and hold down the CLEAR key [11] when switching on using the standby switch, until text appears on the display (about 4 seconds after switching on). If an error message is again displayed, disconnect the instrument from the a.c. line supply and contact your local Wandel & Goltermann service center for advice. The possible error messages are listed in section 3.4 "Error messages".

3 Select application

Press the APPL key [18]. The "Applications" menu is displayed. Select the desired application using the function keys [1] through [6]). Once the selection is made, the transmitter and receiver are set automatically for the application and the main menu page appears on the screen (cf.: Section 3.1.3 "Menu structure, LC display format").

4 Measure

The most important RX and TX settings are shown in two windows on the display:

RX:	Bit rate
	Offset (in ppm/ppb)
	Code (CODE/INTERF.)
	Pattern
	Sensitivity
	Equalizer (ON/OFF)
	Frame Tributary (if framed operation selected)
TX:	Bit rate
	Clock offset (Cal = calibrated)
	Code (CODE/INTERF.)
	Pattern
	Error insertion (e.g. Manual)
	Error type (e.g. Bit)
	Jitter (On/Off), option
	Jitter amplitude (option)
	Jitter frequency (option)
	Frame Tributary (if framed operation selected)

An **error measurement** can be set directly using the main menu page. The individual parameters are set by selecting them by moving the black marker field using the cursor keys [15] and entering the parameter value as described in section 3.1.2 "Parameter entry principle".

The input sensitivity of the SF-60 can be matched to the input signal level. If the signal level is known, input sensitivity can be set to "CCITT" or "PMP" level as required.

Note: If the level is not known, set "**Auto Sense**" before starting the measurement.

More parameters for RX and TX settings are found in the sub-menus "RX Setting" (MAIN MENU, [2]) and "TX Setting" (MAIN MENU, [1]).

Start the measurement by pressing the START key [10] located below the printer unit. The green LED above the key indicates that a measurement is in progress. During the measurement, the error ratio and error count are displayed on the screen.

By pressing the STOP key [10], the **measurement can be stopped** before the set gate time has elapsed. The gate time can be set in the "Measurement" sub menu (MAIN MENU, [4]). The default value for the available applications is 01 min 00 s.

A **printout** of the measurement results is produced when the PRINT key [9] is pressed at the end of the measurement. The printout also includes details of the TX and RX settings used for the application.

Measurement results can be stored and recalled only if a memory card is used.

If the **instrument settings** which have been made are to be **stored** for future use **as a setup**, select the "Memory" menu by pressing the MEM key [20] followed by [1] (Setups). If the settings are to be stored in the **internal memory**, the display must show the Internal Memory list (positions 1 to 10). If this is not the case, press key [1] "Display next range". Move the marker field to a free memory position (FREE) and then press key [3] "Store Act. Setting". The current instrument setting will be stored at the indicated memory position, indicated by the label USED appearing in the display instead of FREE. The setup can also be given another name using function key [5] "Edit Setup Name" (see section 3.1.4, "Menu trees").

To **store** the current **instrument setting on a memory card**, insert a S64K memory card (one card is supplied with the instrument) into the MEMORY CARD slot [C] to the left of the printer unit. The left-hand window of the display must show the "Memcard" list (positions 101 to 110 and 201 to 210). If this is not the case, press key [1] "Display next range". Store the setup as described above. Detailed information on the "Memory" menu is found in section 3.3.10.

Analysis

The default setting for "Analysis" is "Off" in every application that you select from the "Applications" menu. You can select ITU-T G.821 analysis or G.826 analysis (option) from the "Measurement" sub-menu (MAIN MENU, F4).

Automatic measurement of maximum tolerable jitter (MTJ)

The tolerance to jitter of a device under test can be measured automatically using the SF-60. The MTJ measurement is set to off (default) for all of the basic applications which can be selected. The measurement can be activated using the "Measurement" menu (MAIN MENU, [4]).

3.3 Manual operation

The following subsections describe manual operation of the SF-60. The sections are arranged in the same order as the menu trees in section 3.1.4 "Menu trees".

Layout

Each subsection is arranged similarly:

- First of all, a summary of the functions and parameters of the menu described is given.
- The operating procedure starts with a figure showing the menu appearance, after which the functions and parameters are explained briefly. instructions on how to call up the individual functions and parameters complete the description.

Getting started

A rapid overview of the basic steps involved in operating the SF-60 is given in section 3.2 "Getting started (connect up, switch on, select application, measure)".

3.3.1 "Applications" menu

The following applications and corresponding device settings can be selected using the "Applications" menu (APPL key [18]). The first menu level comprises:

Note: The functions assigned to the function keys also depend on the options fitted, i.e. only those menu choices are available which apply to the options fitted to the instrument. As a result, it may sometimes occur that a selection such as STM-1 C12 is not available; the function key is then left unassigned or the other function key assignments move up to fill the blank field. The following descriptions show the menu displays which result when both the SDH and PDH options are fitted.

The first menu level contains the following selections:

- **SDH EXCHANGE, F1**

  A framed signal (SDH) is transmitted and evaluated. The bit rate, line code and pattern for the transmitter and receiver are identical (RX/TX Coupled).

- **SDH MUX, F2**

  For tests on multiplexers: TX signal is a framed pattern; RX signal is STM1.

- **SDH DEMUX, F3**

  For tests on demultiplexers: TX signal is STM1, RX signal is a framed pattern

- **PDH EXCHANGE, F4**

  A framed signal (PDH) is transmitted and evaluated. The bit rate, line code and pattern for the transmitter and receiver are identical (RX/TX Coupled).

- **PDH MUX, F5**

  For tests on multiplexers: TX signal is unframed; RX signal is framed (PDH).

- **PDH DEMUX, F6, F1**

  For tests on demultiplexers: TX signal is framed (PDH); RX signal is unframed.

- **FRAMED PATTERN, F6, F2**

  A framed pattern is transmitted and evaluated. The bit rate, line code and pattern for the transmitter and receiver are identical (RX/TX Coupled).

- **UNFRAMED, F6, F3**

  An unframed signal is transmitted and evaluated. The bit rate, line code and pattern for the transmitter and receiver are identical (RX/TX Coupled).

- **FRAME EDITOR, F6, F4**

  The graphical frame editor can be used to specify the PDH and SDH signal structures for the input and output signals.

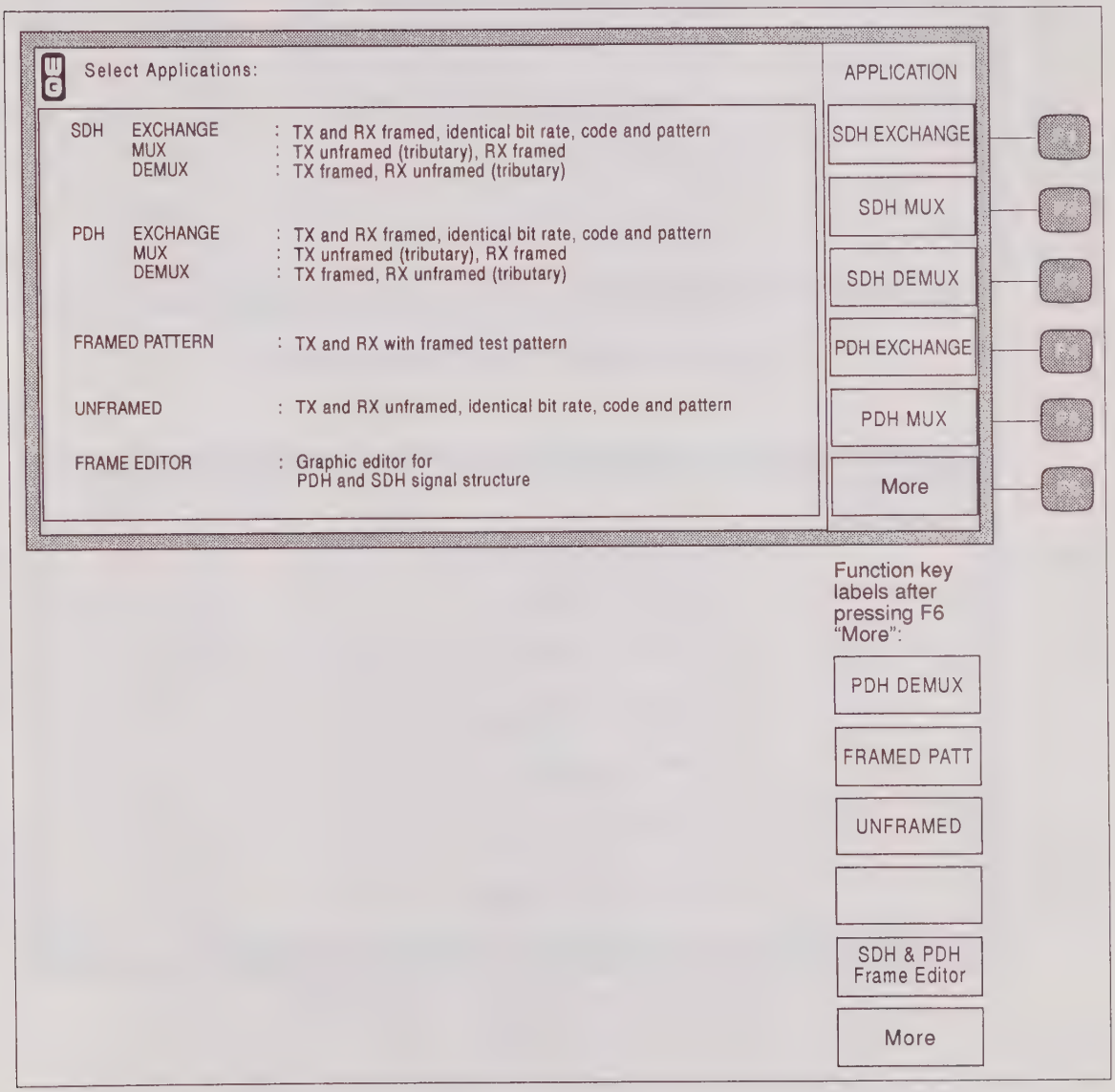

Select Applications:
APPLICATION
SDH EXCHANGE : TX and RX framed, identical bit rate, code and pattern
MUX : TX unframed (tributary), RX framed
DEMUX : TX framed, RX unframed (tributary)
PDH EXCHANGE : TX and RX framed, identical bit rate, code and pattern
MUX : TX unframed (tributary), RX framed
DEMUX : TX framed, RX unframed (tributary)
FRAMED PATTERN : TX and RX with framed test pattern
UNFRAMED : TX and RX unframed, identical bit rate, code and pattern
FRAME EDITOR : Graphic editor for PDH and SDH signal structure
SDH EXCHANGE
SDH MUX
SDH DEMUX
PDH EXCHANGE
PDH MUX
More
F1
F2
F3
F4
F5
F6
Function key labels after pressing F6 "More":
PDH DEMUX
FRAMED PATT
UNFRAMED
SDH & PDH Frame Editor
More

Fig. 3-6 "Applications" menu [18] display, level 1

The second menu level allows selection of the system bit rate for the selected application. The transmitter and receiver will be set to the appropriate bit rate, code and pattern depending on the bit rate selected.

Once the bit rate has been selected, the main menu page is displayed, showing the new instrument settings made.

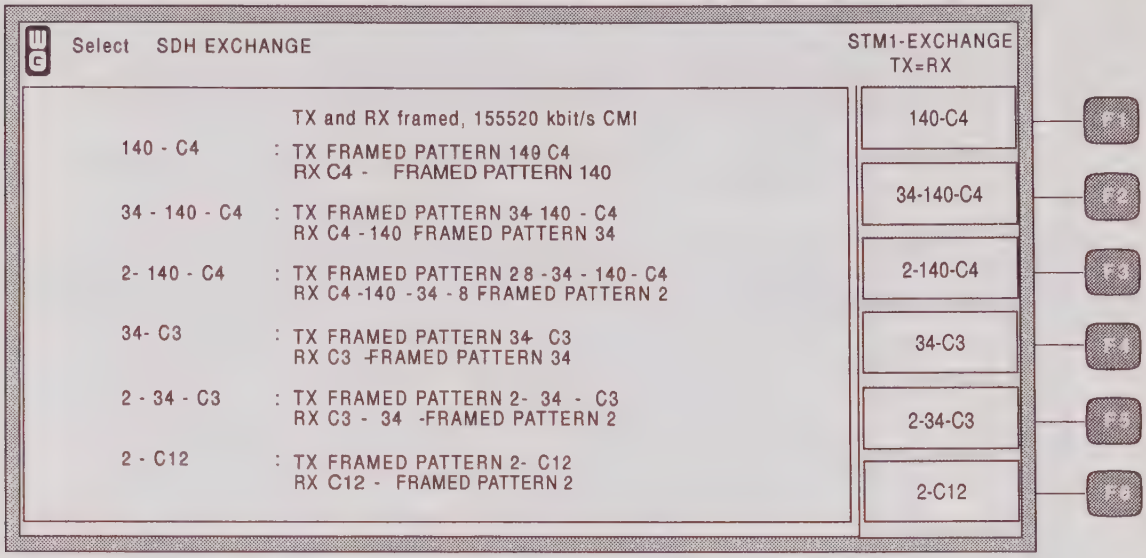

Select SDH EXCHANGE
STM1-EXCHANGE
TX=RX
TX and RX framed, 155520 kbit/s CMI
140 - C4 : TX FRAMED PATTERN 140 C4
RX C4 - FRAMED PATTERN 140
34 - 140 - C4 : TX FRAMED PATTERN 34 140 - C4
RX C4 -140 FRAMED PATTERN 34
2- 140 - C4 : TX FRAMED PATTERN 2 8 - 34 - 140 - C4
RX C4 -140 - 34 - 8 FRAMED PATTERN 2
34- C3 : TX FRAMED PATTERN 34 C3
RX C3 -FRAMED PATTERN 34
2 - 34 - C3 : TX FRAMED PATTERN 2- 34 - C3
RX C3 - 34 -FRAMED PATTERN 2
2 - C12 : TX FRAMED PATTERN 2- C12
RX C12 - FRAMED PATTERN 2
140-C4
34-140-C4
2-140-C4
34-C3
2-34-C3
2-C12
F1
F2
F3
F4
F5
F6

Fig. 3-7 "Applications" [18] menu display, F1 "SDH EXCHANGE"

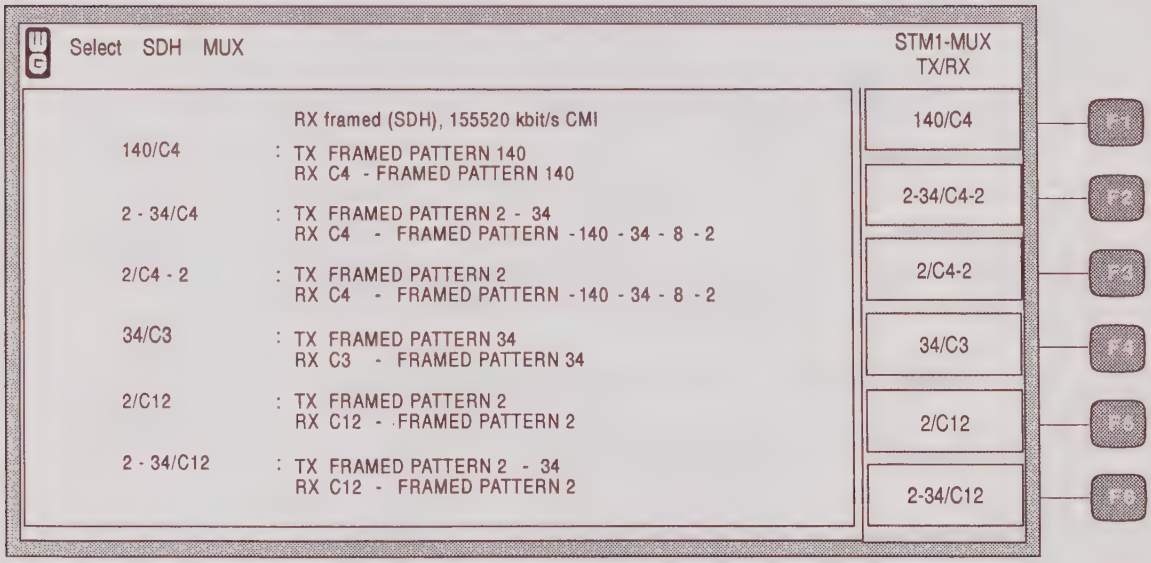

Select SDH MUX
STM1-MUX
TX/RX
RX framed (SDH), 155520 kbit/s CMI
140/C4 : TX FRAMED PATTERN 140
RX C4 - FRAMED PATTERN 140
2 - 34/C4 : TX FRAMED PATTERN 2 - 34
RX C4 - FRAMED PATTERN -140 - 34 - 8 - 2
2/C4 - 2 : TX FRAMED PATTERN 2
RX C4 - FRAMED PATTERN -140 - 34 - 8 - 2
34/C3 : TX FRAMED PATTERN 34
RX C3 - FRAMED PATTERN 34
2/C12 : TX FRAMED PATTERN 2
RX C12 - FRAMED PATTERN 2
2 - 34/C12 : TX FRAMED PATTERN 2 - 34
RX C12 - FRAMED PATTERN 2
140/C4
2-34/C4-2
2/C4-2
34/C3
2/C12
2-34/C12
F1
F2
F3
F4
F5
F6

Fig. 3-8 "Applications" [18] menu display, F2 "SDH MUX"

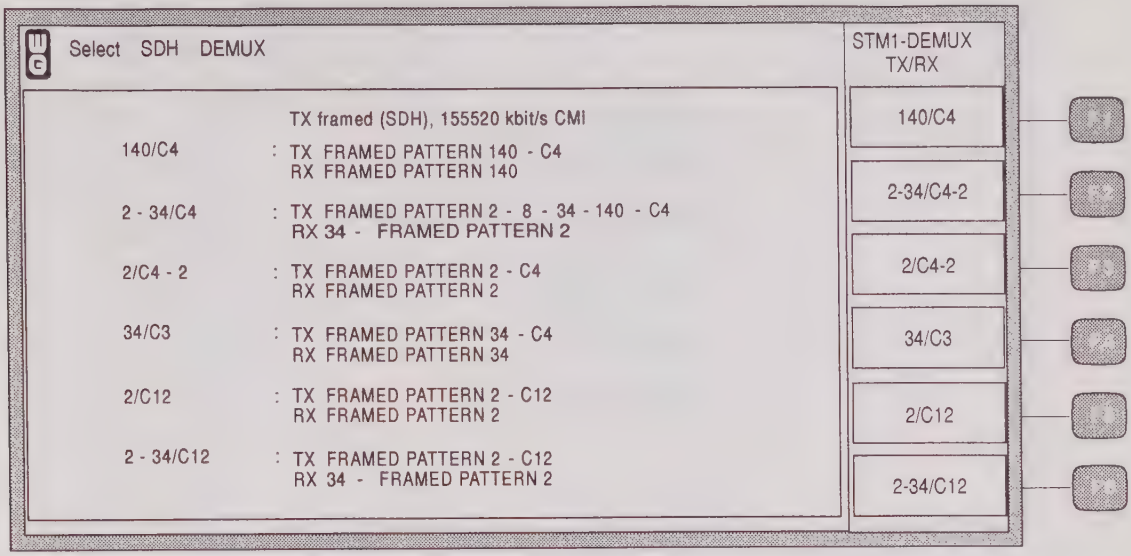

Select SDH DEMUX
STM1-DEMUX TX/RX
TX framed (SDH), 155520 kbit/s CMI
140/C4 : TX FRAMED PATTERN 140 - C4
RX FRAMED PATTERN 140
2 - 34/C4 : TX FRAMED PATTERN 2 - 8 - 34 - 140 - C4
RX 34 - FRAMED PATTERN 2
2/C4 - 2 : TX FRAMED PATTERN 2 - C4
RX FRAMED PATTERN 2
34/C3 : TX FRAMED PATTERN 34 - C4
RX FRAMED PATTERN 34
2/C12 : TX FRAMED PATTERN 2 - C12
RX FRAMED PATTERN 2
2 - 34/C12 : TX FRAMED PATTERN 2 - C12
RX 34 - FRAMED PATTERN 2
140/C4
2-34/C4-2
2/C4-2
34/C3
2/C12
2-34/C12

Fig. 3-9 "Applications" [18] menu display, F3 "SDH DEMUX"

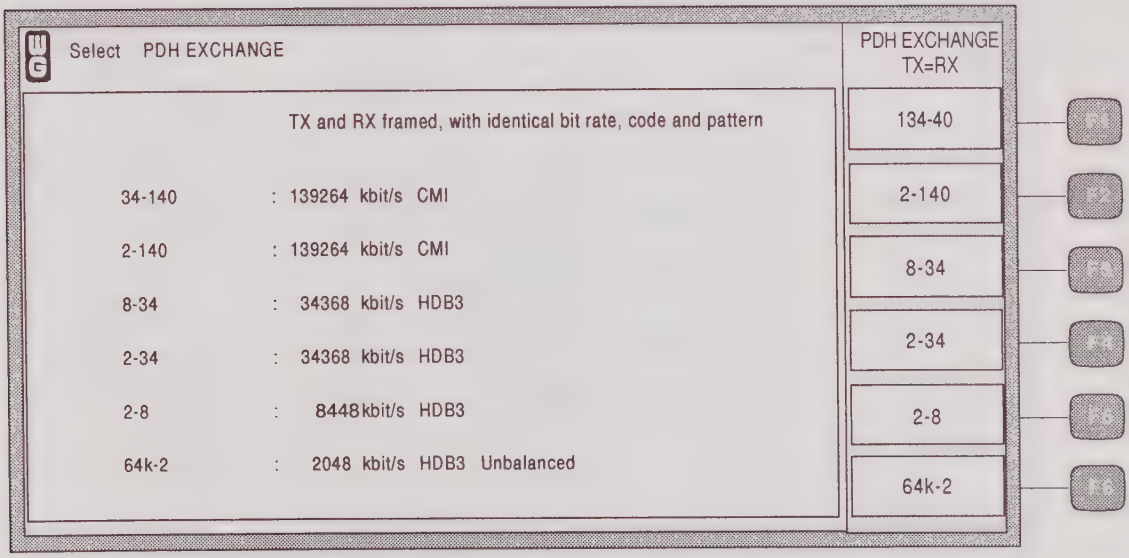


Fig. 3-10 "Applications" [18] menu display, F4 "PDH EXCHANGE"

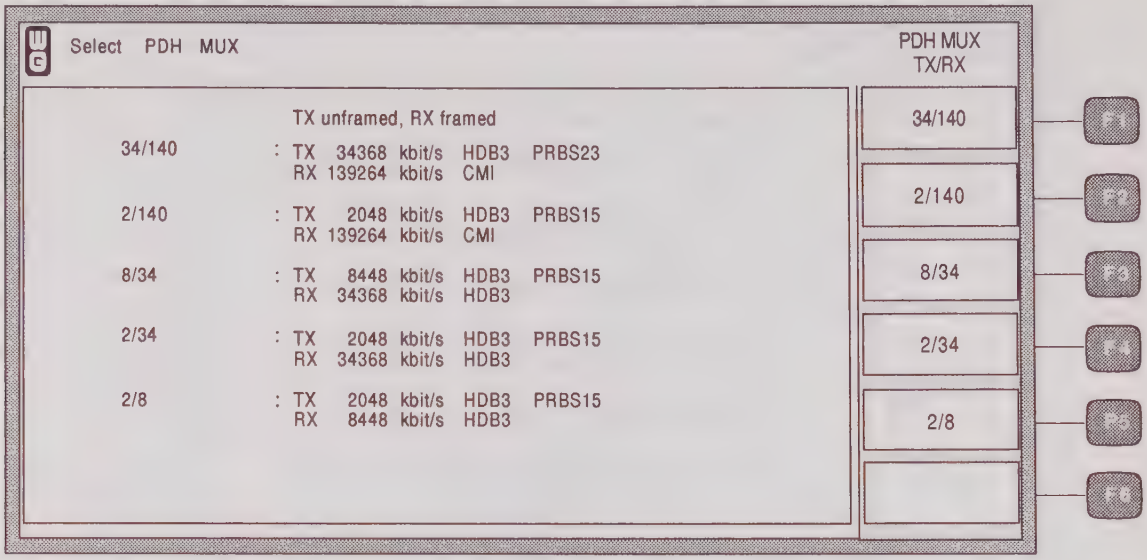


Fig. 3-11 "Applications" [18] menu display, F5 "PDH MUX"

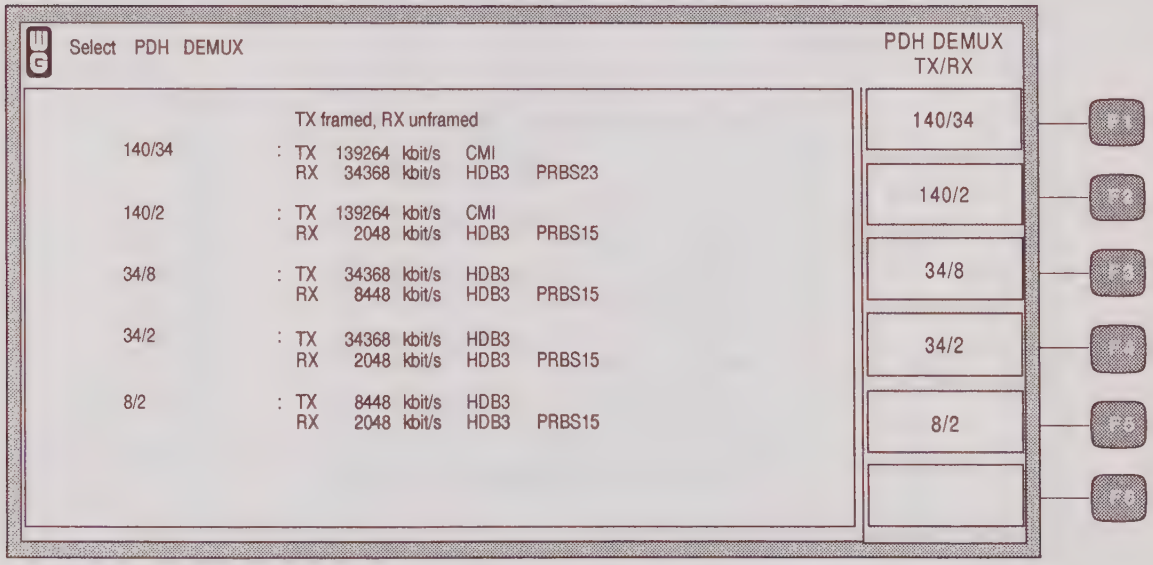


Fig. 3-12 "Applications" [18] menu display, F6, F1 "PDH DEMUX"

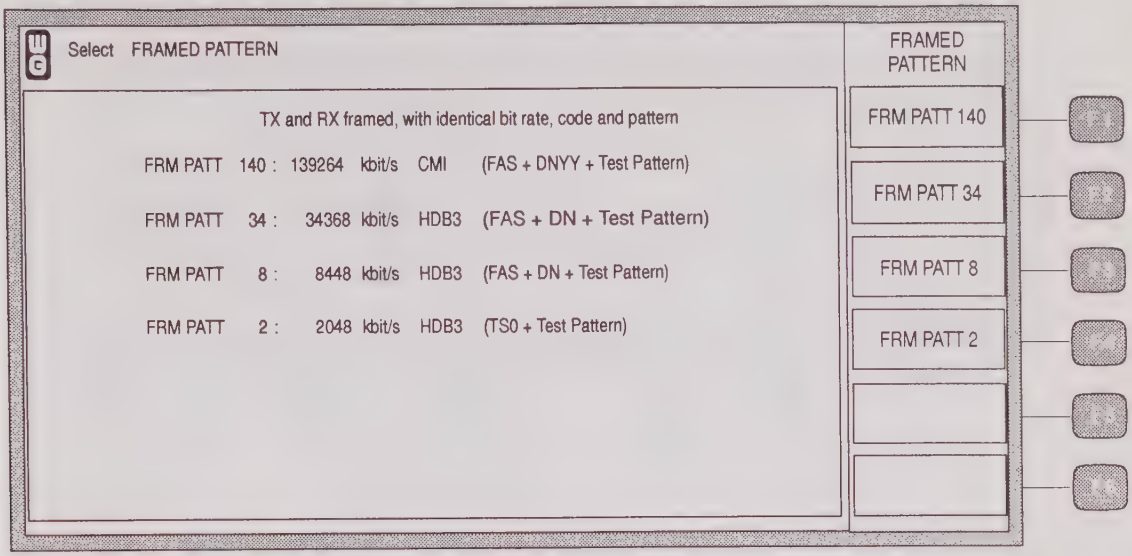

Select FRAMED PATTERN
TX and RX framed, with identical bit rate, code and pattern
FRM PATT 140 : 139264 kbit/s CMI (FAS + DNYY + Test Pattern)
FRM PATT 34 : 34368 kbit/s HDB3 (FAS + DN + Test Pattern)
FRM PATT 8 : 8448 kbit/s HDB3 (FAS + DN + Test Pattern)
FRM PATT 2 : 2048 kbit/s HDB3 (TS0 + Test Pattern)
FRAMED PATTERN
FRM PATT 140
FRM PATT 34
FRM PATT 8
FRM PATT 2

Fig. 3-13 "Applications" [18] menu display, F6, F2 "FRAMED PATTERN"

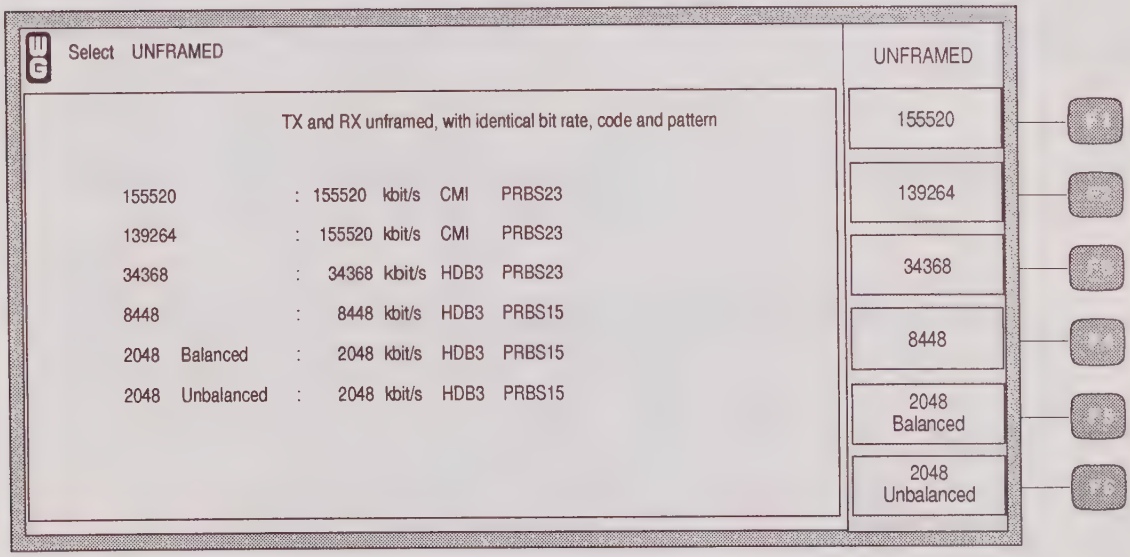

Select UNFRAMED
TX and RX unframed, with identical bit rate, code and pattern
155520 : 155520 kbit/s CMI PRBS23
139264 : 155520 kbit/s CMI PRBS23
34368 : 34368 kbit/s HDB3 PRBS23
8448 : 8448 kbit/s HDB3 PRBS15
2048 Balanced : 2048 kbit/s HDB3 PRBS15
2048 Unbalanced : 2048 kbit/s HDB3 PRBS15
UNFRAMED
155520
139264
34368
8448
2048 Balanced
2048 Unbalanced

Fig. 3-14 "Applications" [18] menu display, F6, F3 "UNFRAMED"

Note: In unframed mode, any bit rate required can be set instead of the preset system values manually using the number keypad or the rotary control. This applies to bit rates within the range 48 kbit/s to 175 Mbit/s (see section 8, "Specifications").

Subsequent alteration of the bit rate is not possible in any other application. To change the TX or RX bit rate, the corresponding application for the desired system bit rate must be selected via the "Applications" menu.

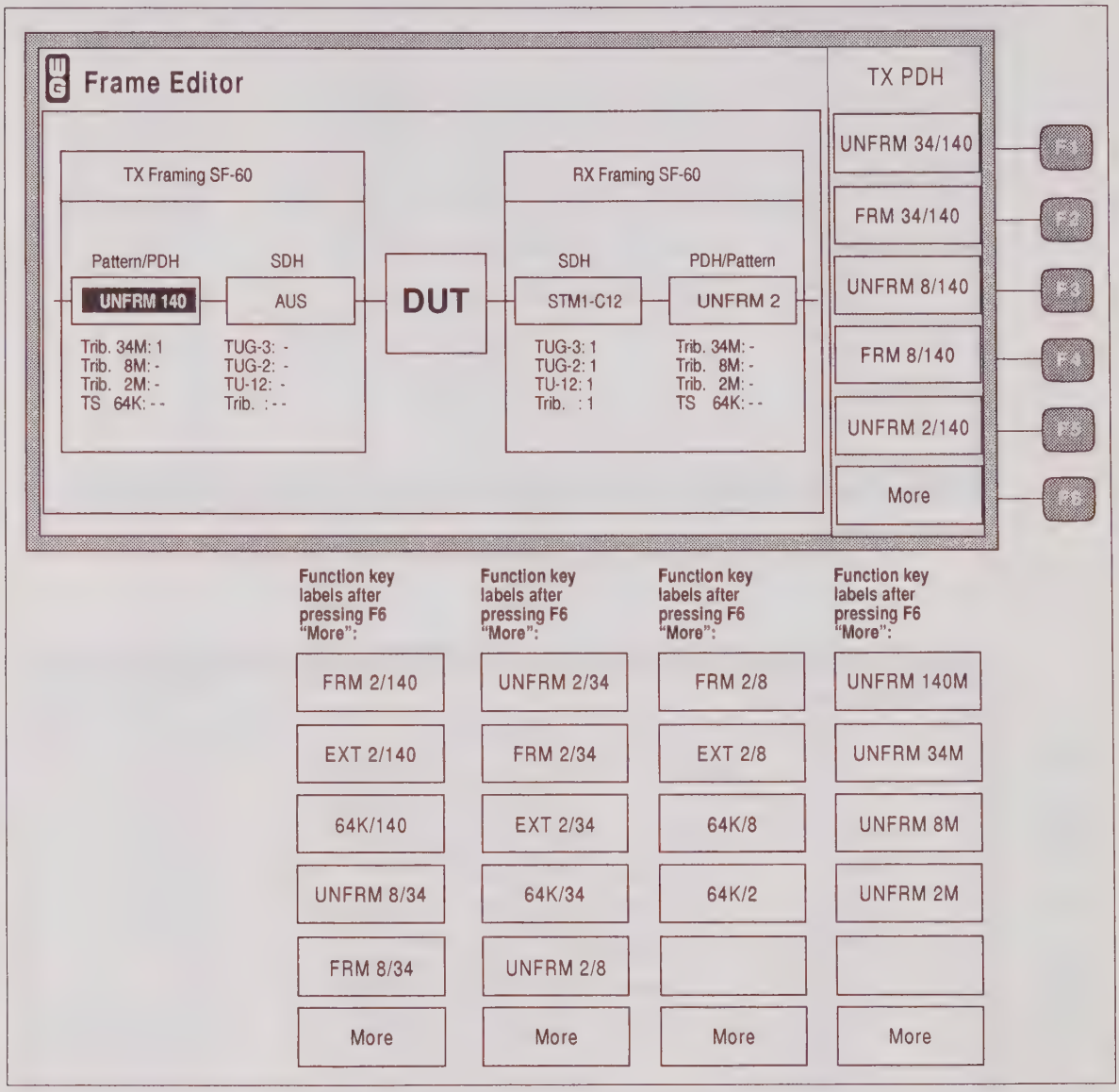


Fig. 3-15 "Applications" [18] menu display, F6, F5 "FRAME EDITOR"

Note: When the PDH and SDH signal structures have been set using the frame editor, the MAIN MENU key [15] must be pressed in order to reach the main menu page. Applications set in this way are entitled "USER APPLICATION"; this title is shown on the main menu page. If the settings made using the frame editor correspond to an application in the pre-set menu, then the title of the corresponding application will be shown instead.

3.3.2 Main menu

The main menu is always displayed:

- When the SF-60 is switched on
- When the MAIN MENU key [15] is pressed once
- When the ESC key [7] is pressed one or more times depending on which menu level below the main menu is displayed originally
- After an application has been selected from the Application menu
- After an autoconfiguration has been performed (Menu key [19]).

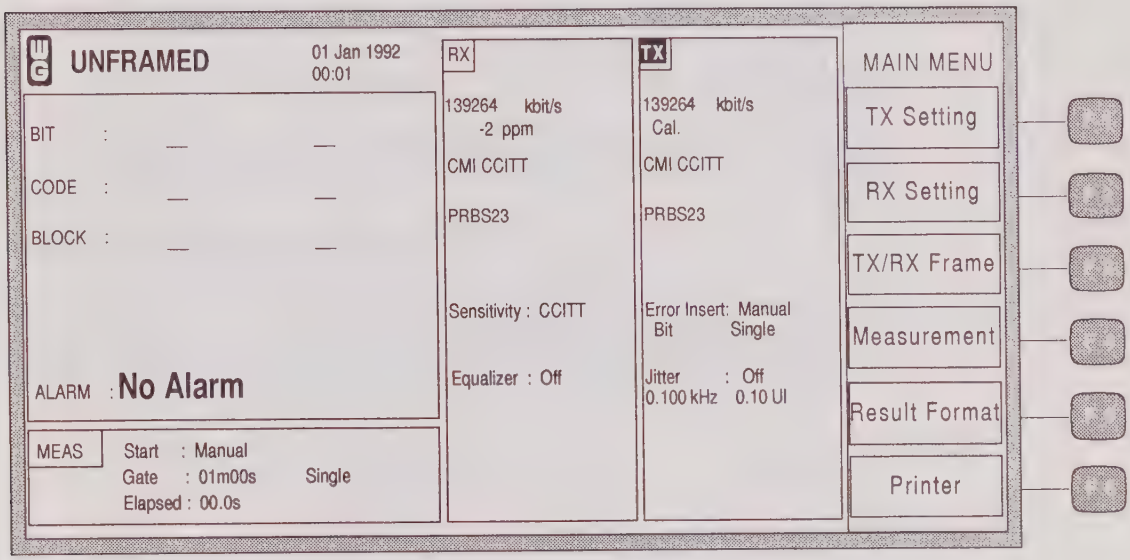


Fig. 3-16 Main menu page after initialization (unframed 139264 kbit/s)

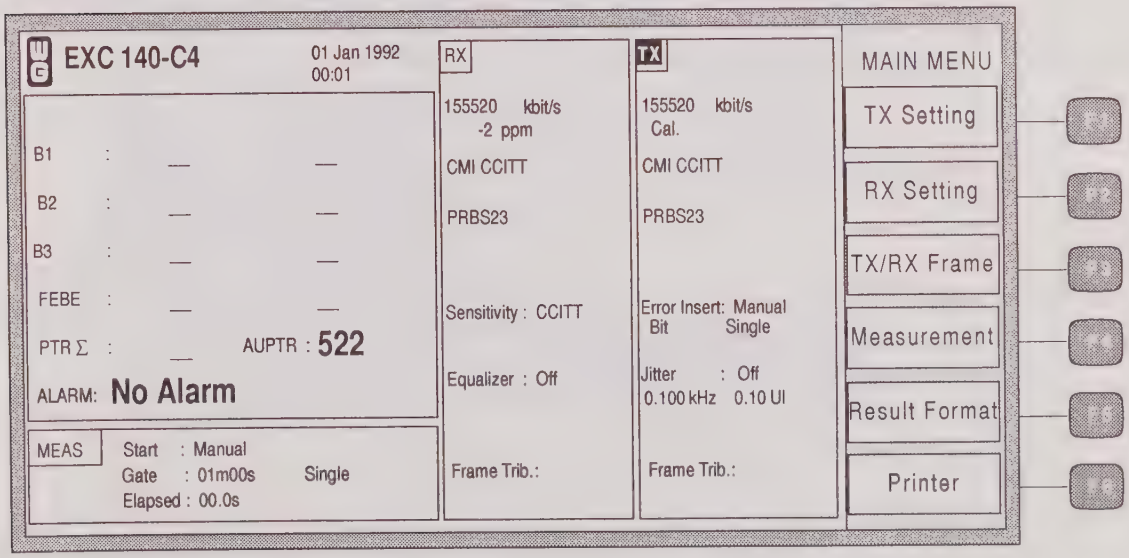


Fig. 3-17 Main menu page after selection of "SDH EXCHANGE 140-C4"

The main menu page gives access to the following functions:

- Transmitter settings:
  - TX bit rate (for unframed operation only)
  - TX clock offset
  - TX code
  - TX pattern
  - Error insertion (Manual, Single)
  - Jitter amplitude, jitter frequency
  - TX channel (Frame Tributary, for framed signals only)
- Receiver settings:
  - RX bit rate (for unframed operation only)
  - RX signal offset display
  - RX pattern
  - Input sensitivity
  - Equalizer on/off
  - RX channel (Frame Tributary, for framed signals only)
- Sub-menus "TX Setting", "RX Setting", "TX/RX Frame", "Measurement", "Result Format" and "Printer".

The cursor is moved between the TX and RX windows using the and keys [15].

Note: The functions of the function keys depend on the options fitted and on the application chosen, i.e. choices of function which are impossible due to the instrument configuration or which are not useful for the selected application will not be displayed. Some of the possible selections shown may therefore be missing; in such cases, the function key field is blank or the labels move up to fill the blank fields.

Transmitter

Setting the TX bit rate (also possible in "TX Setting" menu)

After an application has been selected for which the system bit rate is also selected at the same time, the TX bit rate can only be altered subsequently if the Unframed Error Test mode is selected. If a different bit rate is to be transmitted in framed operation (SDH, PDH EXCHANGE), in MUX or DEMUX mode, a different application with the appropriate bit rate must be selected from the "Applications" menu [18].

- Operating steps:
  To alter the TX bit rate in **unframed applications** ([18], F6, F3), the black marker field must be placed on the TX bit rate field first (using keys [15]). The bit rate is then set as follows:
  Using keys [1] to [6]:
  [1] 155 520 kbit/s (CMI, PRBS 23)
  [2] 139 264 kbit/s (CMI, PRBS 23)
  [3] 34 368 kbit/s (HDB3, PRBS 23)
  [4] 8 448 kbit/s (HDB3, PRBS 15)
  [5] 2048 kbit/s balanced (HDB3, PRBS 15)
  [6] 2048 kbit/s unbalanced (HDB3, PRBS 15)
  Using the number keypad [11], or
  Using the rotary knob [14].
  For the other applications, fixed predetermined bit rates only are available (see figures 3-7 to 3-13).

TX/RX coupling

In the pre-set configurations selected from the "Applications" menu, the transmitter and receiver are coupled in the **SDH EXCHANGE** and **PDH EXCHANGE settings**.

This means that the receiver automatically assumes the same settings as the transmitter in respect of bit rate, code and pattern should these parameters be altered, and vice versa. The TX/RX coupling can be disabled in the "TX Setting" and "RX Setting" menus:

MAIN MENU [15], F1 "TX Setting" or F2 "RX Setting" followed by F2 "RX not coupled to TX".

Setting the TX clock offset (also possible in "TX Setting" menu)

The TX clock offset referred to the set TX bit rate can be set in two ranges:

1 Setting range ± 999 ppm (parts per million = 10^{-6})
2 Setting range ± 999.999 ppb (parts per billion = 10^{-9})

The setting step width varies according to the entry mode selected.

- Operating steps
  Move the marker field to the Offset field (see under bit rate). The preset value is Cal (calibrated).

  Setting range 1: Press [5] (ppm)
  Keys [1] to [3]: [1] Calibrated
  [2] Δ +10 ppm (increase by 10 ppm each time key is pressed)
  [3] Δ -10 ppm (decrease by 10 ppm each time key is pressed)
  - Using the number keypad [11] (in steps of 1 ppm)
  - Using the rotary knob [14] (in steps of 1 ppm)

  Setting range 2: Press [6] (ppb)
  - Keys [1] to [3]: [1] Calibrated
  [2] Δ +10 ppb (increase by 10 ppb each time key is pressed)
  [3] Δ -10 ppb (decrease by 10 ppb each time key is pressed)
  - Using the number keypad [11] (in steps of 0.001 ppb)
  - Using the rotary knob [14] (in steps of 0.001 ppb)

Setting the code (also possible in "TX Setting" menu)

The code which matches the system bit rate is automatically selected when an Application is selected using key [18]. The code can be subsequently altered (e.g if a different bit rate to the preset value is set in unframed operation).

The maximum permissible frequency for the codes

RZ (TTL), NRZ (TTL), AMI, HDB3, B3ZS and CMI (TTL) is 80 Mbit/s.
CMI optical, CMIinv optical: Bit rate range 10 to 100 Mbit/s.

Above this frequency, CMI CCITT is used.

- Operating steps
  Move the marker field to the code displayed using the arrow keys [15]. The codes available are set using the function keys [1] to [6]:
  CMI CCITT, CMI ECL, CMI TTL, CMI optical, CMIinv CCITT, CMIinv ECL, CMIinv TTL, CMIinv optical, HDB3, HDB3 balanced, AMI, AMI 1/1, B3ZS, NRZ ECL, NRZ TTL, NRZ optical, RZ ECL, RZ TTL.

Activating the laser (Optical Interface Option BN 3017/00.02)

If the Optical Interface Option is fitted to the SF-60, the laser is automatically activated when an optical code such as CMI optical or CMIinv optical is selected from the TX window (also possible from the RX window if TX and RX are coupled). The green LED above the output socket of the optical interface [38] will then be on. On the "TX Settings" menu page, an additional line "Laser" appears under "Code"; this is used to switch the laser on or off independently of the code selected.

Setting the TX pattern (also possible in "TX Setting" menu)

The TX pattern is also preset when an Application is selected (see "Applications" menu tree in section 3.1.4). It can also be altered subsequently.

- Operating steps
  Move the marker field to the preset TX pattern displayed (e.g. PRBS 23) using keys [15]. The patterns available are set using keys [1] to [6]:
  PRBS 6, PRBS 7, PRBS 9, PRBS 10, PRBS 11, PRBS 15, PRBS 17, PRBS 19, PRBS 20, PRBS 20&17, QRSS 20, PRBS 23, PRBS 29, PRBS 31, 2 x 8 bits, Bit Pattern 1, Bit Pattern 2, Bit Pattern 3, Bit Pattern 4 and Octet.

Other settings such as transmitting inverted pseudo-random bit sequences and changing the bit patterns 1 - 4 or the 2x8 bit word patterns can only be made using the "TX Setting" sub-menu (MAIN MENU [F1; see section 3.3.3, "TX Setting" menu).

Manual error insertion

The basic setting of error insertion mode for the preset applications is "Single", "Manual" for the error type "Bit". The type of error and the insertion mode **can only be altered from the "TX Setting" sub-menu** (section 3.3.3).

To insert single errors, proceed as follows:

- Operating steps:
  Move the marker field to "Error Insert.: Manual" using the arrow keys [15].
  Press the START key [10] to start measurement required.
  Pressing key [1] inserts an error; the key can be pressed as often as required.

The preset value of the "Gate Time" is 01m00s (1 minute). The errors inserted and the error ratio for the measurement in progress are indicated continuously in the left-hand half of the display next to the corresponding counters. The measurement can be stopped prematurely by pressing the STOP key [10]. The gate time can be altered in the "Measurement" menu (Main Menu, F4); see section 3.3.6, "Measurement" menu for details.

Set jitter generation (with option BN 2074/00.15) (also possible in "TX Setting" menu)

The preset value for jitter generation is "Off". The jitter amplitude and frequency are given on the main menu page under "Jitter: Off"; these parameters can be altered. The maximum tolerance to jitter curves for the SF-60 at the various bit rates are given in the Specifications, section 8.1.5.2. The graphs show the corner values for jitter amplitude and frequency.* Operating steps:

Operating steps:
Move the marker field to "Jitter" using the arrow keys [15].
Press [2] ("On")
Move the marker field to the left to indicate the "Frequency" parameter ("0.100 kHz")
The function keys [1] to [6] can be used to set the following values:
[1] 0.02 kHz
[2] 0.1 kHz
[3] 0.2 kHz
[4] 100 kHz
[5] 800 kHz
[6] 3500 kHz

– The number keypad and
– the rotary knob
can also be used for entering frequency values. The SF-60 can handle jitter frequencies in the range 2 Hz to 4.5 MHz.
– Move the marker field to the right to the parameter "Amplitude" ("0.01 UI") using the right arrow key [15].
The function keys [1] to [6] can be used to set the following values:
[1] 0.15 UI
[2] 0.20 UI
[3] 0.75 UI
[4] 1.5 UI
[5] 5.0 UI
[6] 10.0 UI
– The number keypad and
– the rotary knob

can also be used for entering amplitude values. The setting step width for amplitude is divided into two ranges:
1 Max. jitter amplitude 2.49 UI_{pp}: Step width 0.01 UI_{pp}
2 Jitter amplitude 2.5 to 20 UI_{pp}: Step width 0.1 UI_{pp}

The SF-60 can handle jitter amplitudes in the range 0 to 20 UI_{pp}. The maximum intrinsic jitter measured at clock output [34] to ITU-T Rec. O.171 is 0.006 UI_{pp}.

Further information is found in the Specifications, section 8.1.5 "Jitter generation".

Setting the TX channel (Frame Tributary, for framed signals only, also possible from "TX/RX Frame" menu)

For framed signals, the current TX tributary (1 to 63 STM–1 C–12, 1 to 3 STM-1 C3 or 1 to 31 for primary systems) is constantly indicated in the TX window (bottom) on the main menu page. The default setting is tributary no. 1 (see figure 3-18)

Selection of a different tributary is only possible from the "TX/RX Frame" menu.

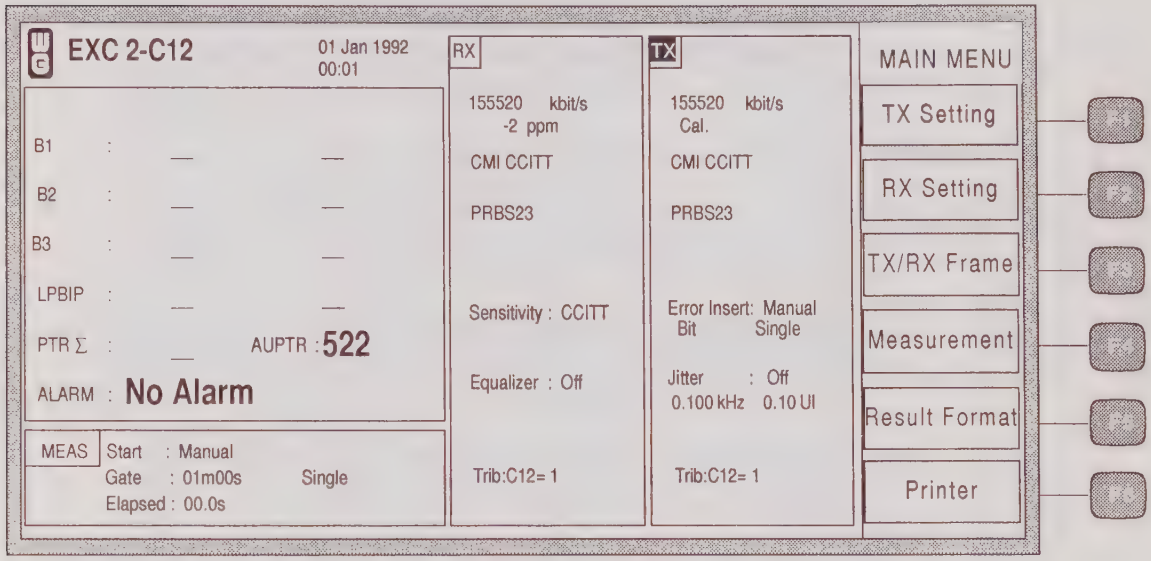


Fig. 3-18 Main menu page for "SDH EXCHANGE 2-C12" application

Receiver

Setting the RX bit rate (also possible in "RX Setting" menu)

The current internal RX bit rate is displayed on the main menu page in the same way as the TX bit rate. After an application has been selected for which the RX bit rate is also selected at the same time, the RX bit rate can only be altered subsequently if the Unframed Error Test mode is selected. If a different internal RX bit rate is required for a Framed Error Test (SDH, PDH EXCHANGE), MUX Test or DEMUX Test, a different application with the appropriate bit rate must be selected from the "Applications" menu (APPL key [18]).

- Operating steps (for "Unframed Error Test"):
  Move the marker to the RX bit rate field in the RX window (using keys [15]).
  The bit rate is then set as follows:
  Using keys [1] to [6]:
  [1] 155520 kbit/s (CMI, PRBS 23)
  [2] 139264 kbit/s (CMI, PRBS 23)
  [3] 34368 kbit/s (CMI, PRBS 23)
  [4] 8448 kbit/s (CMI, PRBS 15)
  [5] 2048 kbit/s balanced (HDB3, PRBS 15)
  [6] 2048 kbit/s unbalanced (HDB3, PRBS 15)
  Using the number keypad [11], or
  Using the rotary knob [14].

For the other applications, fixed predetermined system bit rates only are available.

TX/RX coupling

The preset values for Unframed Error Test and Framed Error Test which are selected via the "Applications" menu include coupling of the transmitter and receiver.

This means that the transmitter automatically assumes the same settings as the receiver in respect of bit rate, code and pattern should these parameters be altered, and vice versa. The TX/RX coupling can be disabled in the "TX Setting" and "RX Setting" menus: MAIN MENU, [1] or [2], [2] (RX not coupled to TX).

Received signal offset (also possible in "RX Setting" menu)

The offset (± 999 ppm) of the clock signal recovered from the RX signal is displayed continuously in the RX window below the "Bit rate" parameter.

Setting the RX pattern (also possible in "RX Setting" menu)

The RX pattern is also preset when an Application is selected (see "Applications" menu tree in section 3.1.4). It can also be altered subsequently.

- Operating steps
  Move the marker field to the preset RX pattern displayed (e.g. PRBS 23) using the arrow keys [15]. The patterns available are set using keys [1] to [6]:
  PRBS 6, PRBS 7, PRBS 9, PRBS 10, PRBS 11, PRBS 15, PRBS 17, PRBS 19, PRBS 20, PRBS 20&17, QRSS 20, PRBS 23, PRBS 29, PRBS 31, 2 x 8 bits, Bit Pattern 1, Bit Pattern 2, Bit Pattern 3, Bit Pattern 4 and Octet.

Setting the RX sensitivity (also possible in "RX Setting" menu)

The input sensitivity of the SF-60 can be matched to the input signal level. If the signal level is known, the sensitivity can be set to "CCITT" or "PMP" as appropriate.

Note: If the signal level is not known, the sensitivity must be set to "**Auto Sense**" **before** the measurement is started.

- Operating steps
  Move the marker field to the parameter "Sensitivity: CCITT" (center of RX window)
  Select the level using keys [1], [2] or [6]:
  [1] CCITT
  [2] PMP
  [6] Auto Sense

If the signal level is below the set sensitivity level, the message "No Signal" is displayed.

Activating the equalizer (also possible in "RX Setting" menu)

The proportional increase in attenuation of the connecting cables with increasing frequency can be equalized on the receive side within certain limits using the two built-in adaptive line equalizers.

One equalizer is provided for each of the two bit rates 34 Mbit/s and 140/155 Mbit/s. Equalization is based on the main frequencies 17.2 MHz (for 34 Mbit/s) and 70 MHz (for 140/155 Mbit/s). The setting range is from 0 to 12 dB in each case.

The permissible operating range of the equalizer for the preset settings depends on the selected bit rate and code (see section 8.2.2.2 "Signal conditioning").

The setting range for the input signal amplitude (nominal value) is 0.05 to 4.00 V. If the signal level is below the set amplitude range, the message "No Signal" is displayed.

Setting the RX channel (Tributary; for framed signals only, also possible from "TX/RX Frame" menu)

The current RX tributary (1 to 63 for STM–1 C–12, 1 to 3 for STM-1 C3 or 1 to 31 for primary systems) is constantly indicated in the RX window (bottom) on the main menu page. The default setting is tributary no. 1 as for the TX channel setting (see figure 3-18).

Selection of a different tributary is only possible from the "TX/RX Frame" menu.

3.3.3 "TX Setting" menu

To open the "TX Setting" menu, start from the main menu page. If a menu other than the main menu is displayed, press the MAIN MENU key [15].

Now press key [1]. The "TX Setting" menu is displayed in the right-hand half of the display instead of the RX and TX windows (see figure 3-19).

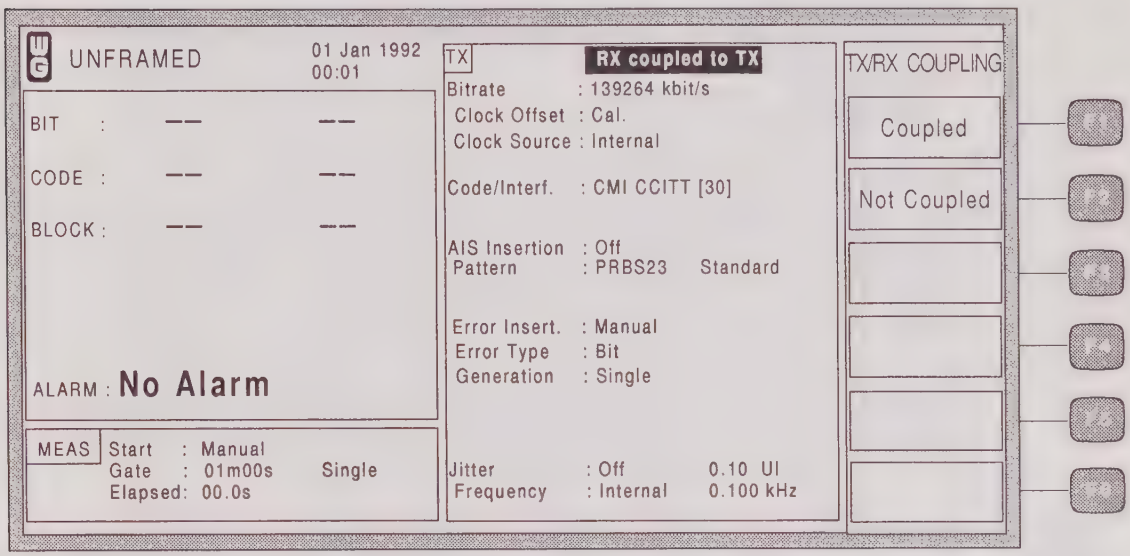


Fig. 3-19 Example of "TX Setting" menu display

The "TX Setting" menu gives access to the following functions:

- Set TX/RX coupling
- Set TX bit rate (unframed operation only, see section 3.3.2 "Main menu")
- Set TX clock offset (see section 3.3.2 "Main menu")
- Select clock source (Internal, External, External 2048 kHz)
- Set code/interface (see section 3.3.2 "Main menu")
- Activate/deactivate laser for optical interface (only if option BN 3017/00.02 fitted)
- Select pulse amplitude for codes RZ (TTL), NRZ (TTL), AMI, HDB3, B3ZS, CMI (TTL)
- Transmit AIS (pattern is "all ones")
- Set TX pattern, transmit "normal" or "inverted"
- Select error insertion type
- Select error type
- Select error generation type
- Select jitter generation (amplitude, frequency, only possible if option BN 2074/00.15 fitted, see section 3.3.2 "Main menu")

TX/RX Coupling

The preset values for "UNFRAMED" and "SDH or PDH EXCHANGE" applications which are selected via the "Applications" menu include coupling of the transmitter and receiver ("RX coupled to TX"). In the "SDH or PDH MUX" and "SDH or PDH DEMUX" applications, the transmitter and receiver are not coupled ("RX not coupled to TX"). The status is indicated on the "TX Settings" and "RX Settings" menu pages in the first line. The TX/RX coupling status can be altered for "UNFRAMED" and "SDH or PDH EXCHANGE" as follows:

- Operating steps
  Move the marker to the first line of the menu page using the arrow keys [15]
  Select mode using [1] or [2]
  [1] (coupled).
  [2] (not coupled)

Activate / deactivate laser (only if option BN 3017/00.02 fitted)

If the Optical Interface Option is fitted to the SF-60, the laser is automatically activated when an optical code is selected (**optical cables must be connected to [38] and [39]**). The application "SDH EXCHANGE" (C4, C3, C12) must be selected first.

Note: If the SF-60 indicates a LOM alarm when no input signal is present, set the application again using the APPL key and repeat the measurement.

The green LED above the output socket of the optical interface [38] will then be on. On the "TX Settings" menu page, an additional line "Laser" appears under "Code"; this is used to switch the laser on or off independently of the code selected. (see figure 3-20).

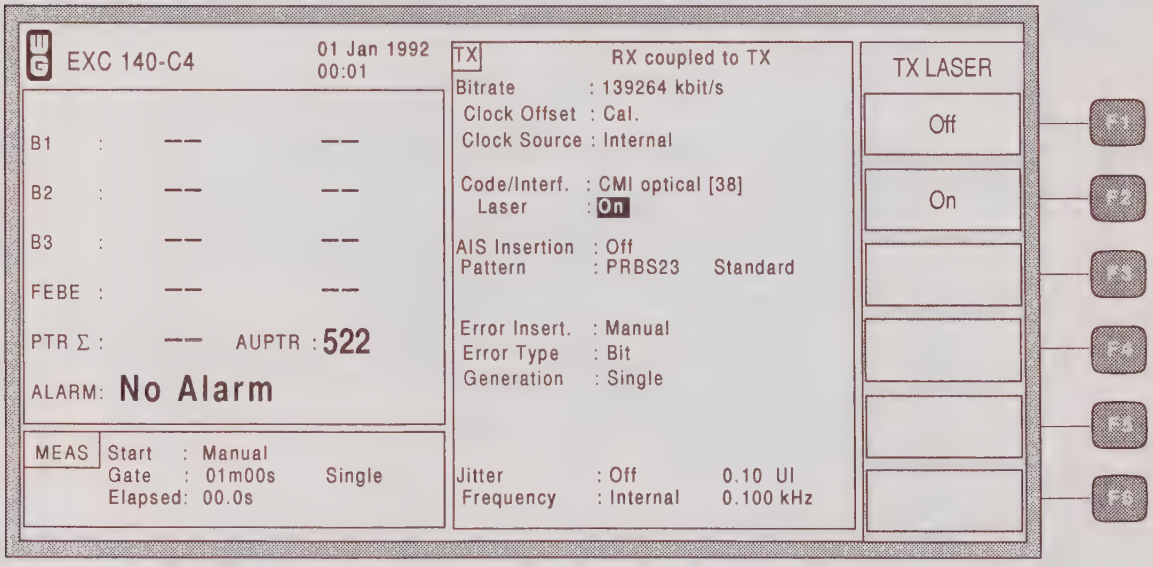


Fig. 3-20 "TX Setting" menu display for "Framed Error Test", "STM-1 C-4" application with Code = CMI optical [38]

All other parameters in this menu

are marked as described under "TX/RX coupling". The possible selections for each parameter are given in the "TX Setting" menu tree in section 3.1.4.

3.3.4 "RX Setting" menu

To open the "RX Setting" menu, start from the main menu page. If a menu other than the main menu is displayed, press the MAIN MENU key [15].

Now press key [2]. The "RX Setting" menu is displayed in the right-hand half of the display instead of the RX and TX windows (see figure 3-21).

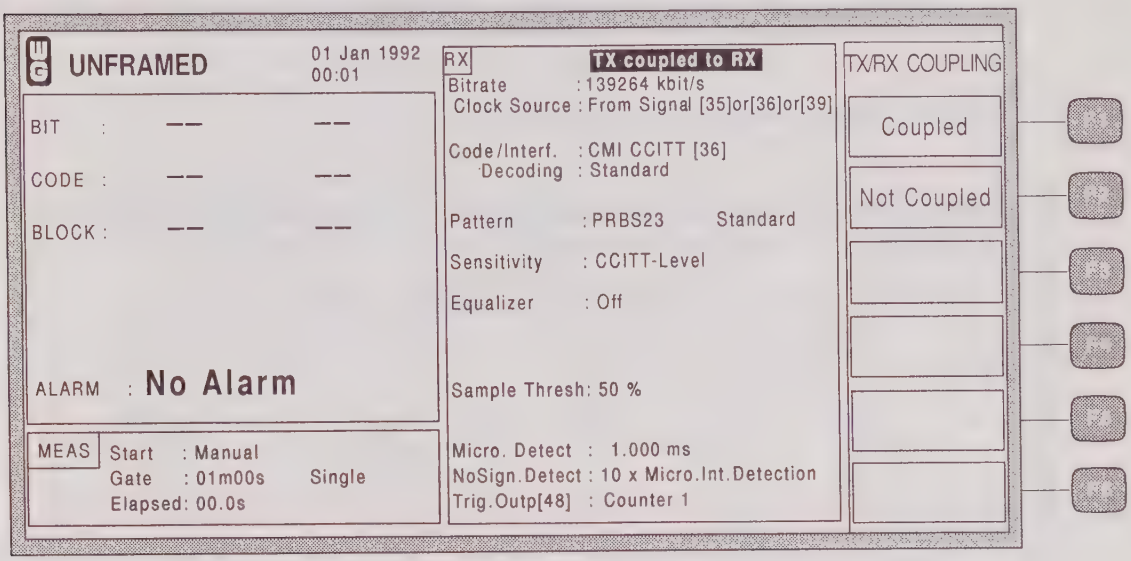


Fig. 3-21 Example of "RX Setting" menu display

The "RX Setting" menu gives access to the following functions:

- Set TX/RX coupling
- Set TX bit rate (unframed operation only)
- Select clock source (signal input [35], [36] or [39], External)
- Set code/interface (see section 3.3.2 "Main menu")
- Select decoding method (standard or modified, see section 8.2.2 "Decoding method")
- Select pattern (see section 3.3.2 "Main menu")
- Select input sensitivity (CCITT, PMP or Auto Sense as in section 3.3.2)
- Select equalizer (34 Mbit/s or 140/155 Mbit/s as in section 3.3.2)
- Select nominal amplitude (only if equalizer on)
- Select sample threshold
- Program micro-interrupt detection (M-Int)
- Program wait time for "No Signal (m-int)" detection
- Select event to be output as trigger to output [48] ("Trig. Output [48]")

Parameters are marked as described under "TX Setting". More information on the parameters is found in section 3.3.2 "Main menu". The possible selections for each parameter are given in the "RX Setting" menu tree in section 3.1.4.

3.3.5 "TX/RX Frame" menu

To open the "TX/RX Frame" menu, start from the main menu page. If a menu other than the main menu is displayed, press the MAIN MENU key [15].

Now press key [3]. The "TX/RX Frame" menu is displayed in the right-hand half of the display instead of the RX and TX windows. The menu appearance varies according to the application (bit rate) selected, so that the functions available in the "TX/RX Frame" menu also differ. The following sub-sections show the menus which appear for the various applications which can be selected in the "Applications" menu (key [18]).

3.3.5.1 "TX/RX Frame" menu for "UNFRAMED"

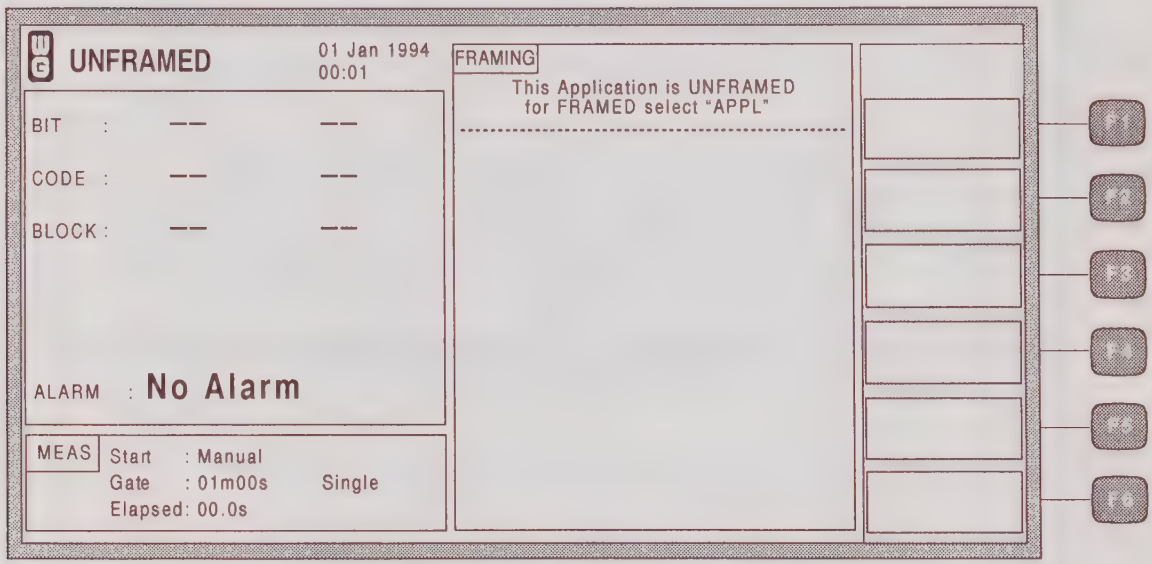


Fig. 3-22 Example of "TX/RX Frame" menu for "UNFRAMED" application

3.3.5.2 "TX/RX Frame" menu for "SDH EXCHANGE 2-C12" application

The menu page can be switched between SDH and PDH framing menus. The "PDH framing" menu is identical to that of the "PDH EXCHANGE" application.

The "TX/RX Frame" menu gives access to the following functions (figure 3-23):

SDH framing

- Select mappping method (asynchronous, bit synchronous)
- Switch scrambler off/on (default = on)
- Select TX frame tributary (TUG-3, TUG-2, TU-12)
- Offset frame tributary
- Transmit selected alarms (e.g. LOS, LOF, AU-LOP, AU-AIS, etc.)
- Select alarm generation and alarm cycle (see figure 3-24)
- Select internal/external trigger (via socket [52])
- Edit TX SOH bytes (except B1, B2 and B3 bytes), VC4-POH und VC12-POH and V5 byte (bits 4-8), see figure 3-26. Alter hexadecimal/binary value of one or more bytes statically (figure 3-27)
  Occupy one byte over 64 frames with an ASCII or hexadecimal sequence (figures 3-28 to 3-30)
  Dynamically occupy a byte or group of bytes with a TX pattern or a pattern via the V.11 interface (figure 3-32)
- Switch descrambler off/on (default = on)
- Select RX frame tributary (TUG-3, TUG-2, TU-12)
- Select trigger to output [54]
- Select SOH/POH byte from which a sequence from 64 consecutive frames is to be stored (can be shown as hexadecimal and ASCII values in the left-hand half of the display using the "Result Format" menu)
- Select SOH, POH or byte groups from the SOH to be evaluated or passed on to the V.11 interface (figure 3-33)

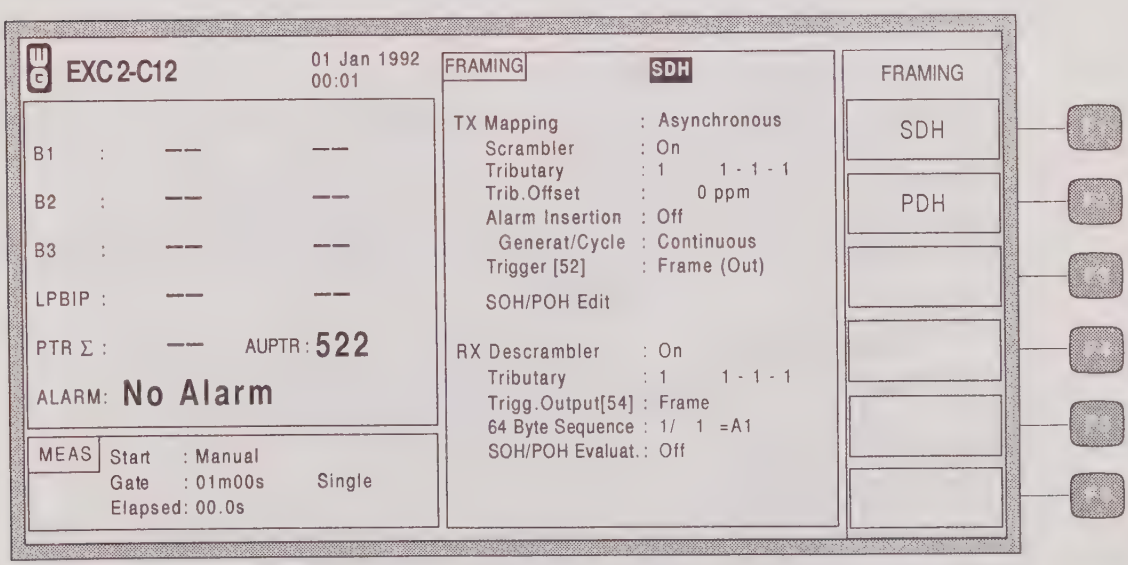


Fig. 3-23 "TX/RX Frame" menu for "SDH Exchange 2-C12" application

Mapping procedure

Asynchronous operation (C12 mapping):
Using variable positive justification and fixed negative justification at a rate of 3/7.
VC-12 POH: The last 5 bits of the V5 byte are 0 0 1 0 0

Synchronous operation (C12 mapping):
With TU-12 Pointer operations (Increments, Decrements, no NDF)
VC-12 POH: The last 5 bits of the V5 bytes are: 0 0 1 1 0

Scrambling procedure

The scrambler can be activated/deactivated. The scrambling procedure uses the 7 bit polynomial specified by ITU-T Rec. G.709.

TX tributary

A TX tributary between 1 and 63 can be selected. The position of the selected tributary in the TUG-3, TUG-2 and TU-12 is displayed.

Tributary offset (offset of the sub-system)

The offset range depends on the mapping procedure selected:

C12 mapping (asynchronous mode): ± 100 ppm, in 5 ppm steps
C12 mapping (synchronous mode): ± 30 ppm, in 5 ppm steps
C3 mapping: ± 60 ppm, in 5 ppm steps
C4 mapping: ± 50 ppm, in 5 ppm steps

Alarm insertion

Figure 3-24 shows the alarms which can be inserted by pressing a key. The "Alarm insertion" table in section 8.4.1.3 shows the position in the frame where the alarm is inserted. The table can also be used to determine which bits in the SOH/POH matrix can be altered manually in order to generate the alarms.

Note: If alarm insertion is selected, error insertion is always disabled.

Alarm generation, alarm cycle

Alarm generation may be continuous, for a specified number of frames N (N = 1 to 999) or for a defined time (0.1 to 9.8 seconds).

For the two latter possibilities, the alarm cycle must also be specified:
For N frames: 0.2 to 9.9 seconds
For N seconds: 0.2 to 9.9 seconds; the cycle must be longer than the selected duration of alarm insertion.

Trigger [socket 52]

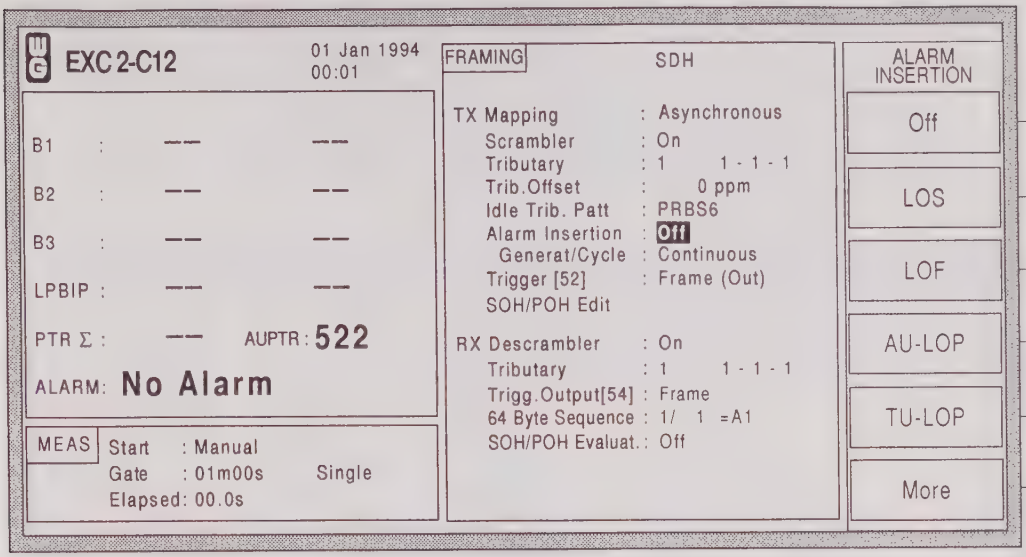
The "Trigger" socket [52] can be configured as an input or as an output:

Output:

- frame trigger
- multiframe trigger
- 8 kHz signal derived from system bit rate, used for synchronizing external devices.

Input:

- Signal for synchronizing the TX frame to the positive clock edge of an external trigger pulse 200 ns (F-Sync.)
- Signal for synchronizing the multiframe toe the positive clock edge of an external trigger pulse 200 ns (MF-Sync.).



Functions keys after pressing F6 "More":

- LOM
- AU-AIS
- TU-AIS
- MS-AIS
- MS-FERF
- More

Functions keys after pressing F6 "More":

- HP-FERF
- LP-FERF
- HP-UNEQ
- LP-UNEQ
- (empty)
- More

Fig. 3-24 "TX/RX Frame" menu for alarm insertion of "SDH Exchange 2-C12" application

Alter SOH/POH

The following figures show the alterations which can be made to the SOH/POH frame and VC-12 POH (V5 byte). The alterations which have been made can be seen on the left-hand half of the display (results page). Select the "Results Format" sub-menu [5] from the main menu page and then select [3] "SOH/POH monitor" from the sub-menu.

Use function key F1 to call up the graphic display of the SOH/POH. Press function key F6 "SOH/POH Default" to reinstate the default settings for SOH and POH.

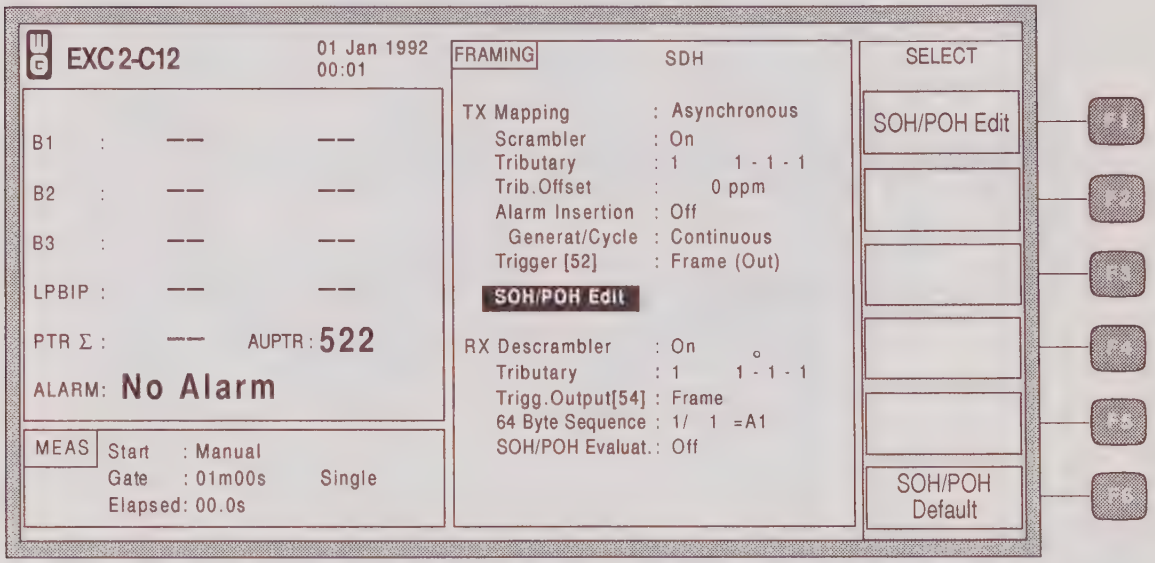


Fig. 3-25 "TX/RX Frame" menu: Call up SOH/POH mask for editing

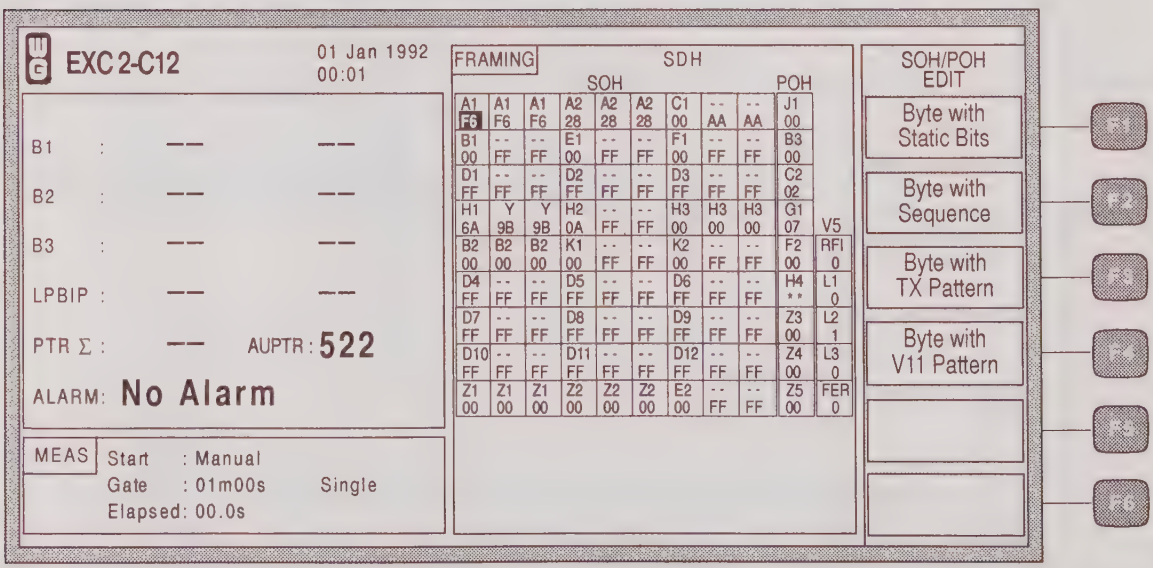

EXC 2-C12
01 Jan 1992
00:01
B1 : -- --
B2 : -- --
B3 : -- --
LPBIP : -- --
PTR Σ : -- AUPTR : 522
ALARM: No Alarm
MEAS Start : Manual
Gate : 01m00s Single
Elapsed: 00.0s
FRAMING SDH
SOH POH
A1 F6 | A1 F6 | A1 F6 | A2 28 | A2 28 | A2 28 | C1 00 | -- AA | -- AA | J1 00
B1 00 | -- FF | -- FF | E1 00 | -- FF | -- FF | F1 00 | -- FF | -- FF | B3 00
D1 FF | -- FF | -- FF | D2 FF | -- FF | -- FF | D3 FF | -- FF | -- FF | C2 02
H1 6A | Y 9B | Y 9B | H2 0A | -- FF | -- FF | H3 00 | H3 00 | H3 00 | G1 07 | V5
B2 00 | B2 00 | B2 00 | K1 00 | -- FF | -- FF | K2 00 | -- FF | -- FF | F2 00 | RFI 0
D4 FF | -- FF | -- FF | D5 FF | -- FF | -- FF | D6 FF | -- FF | -- FF | H4 * * | L1 0
D7 FF | -- FF | -- FF | D8 FF | -- FF | -- FF | D9 FF | -- FF | -- FF | Z3 00 | L2 1
D10 FF | -- FF | -- FF | D11 FF | -- FF | -- FF | D12 FF | -- FF | -- FF | Z4 00 | L3 0
Z1 00 | Z1 00 | Z1 00 | Z2 00 | Z2 00 | Z2 00 | E2 00 | -- FF | -- FF | Z5 00 | FER 0
SOH/POH EDIT
Byte with Static Bits
Byte with Sequence
Byte with TX Pattern
Byte with V11 Pattern
F1
F2
F3
F4
F5
F6

Fig. 3-26 "TX/RX Frame" menu after pressing F1 "SOH/POH view"

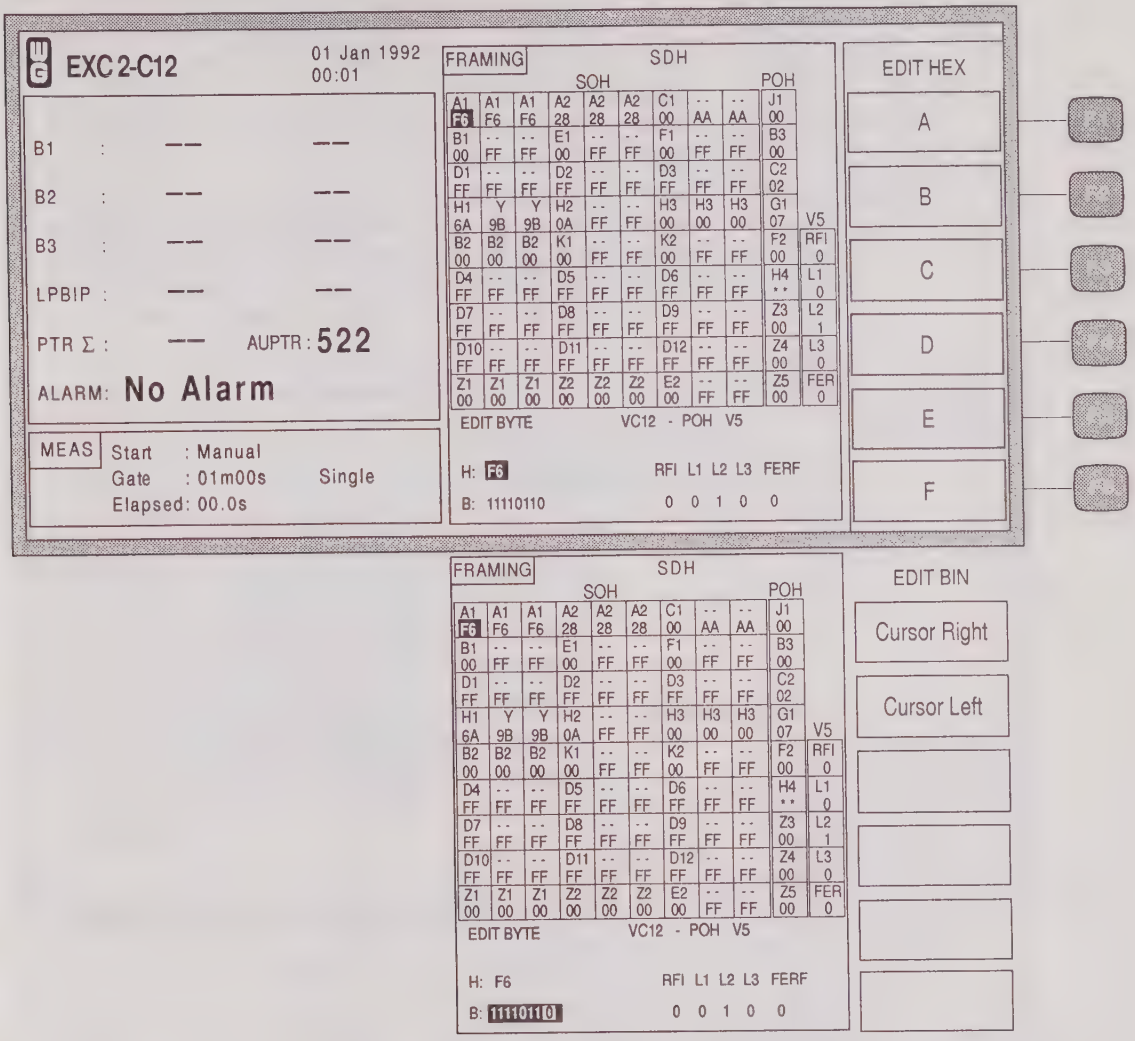


Fig. 3-27 "SOH/POH view" after selecting F1 "Byte with static bits"

When [1] "Byte with static bits" is selected, the hexadecimal and binary values of a byte (other than B1, B2, B3) previously selected using the cursor keys [15] can be altered statically. The standard overhead is shown in section 8.4.1.3.

Altering the V5 byte (VC12-POH)

In the graphic display of SOH, VC4 and VC12 POH (= V5 byte), the V5 byte (bits 4 to 8: RFI, L1, L2, L3, FERF) **cannot** be accessed with the cursor. The V5 byte is displayed below the graphics only after F1 "Byte with static bits" is selected, where it can be marked with the cursor and altered. Any changes made are reflected in the graphic V5 byte display above the value.

The following figures 3-28 to 3-31 show the possible selections available after pressing [2] "Byte with sequence".

ASCII-64 BYTE: A previously marked byte can be filled with a user-defined ASCII value sequence for 64 frames.

HEX-64 BYTE: A previously marked byte can be filled with a user-defined HEX value sequence for 64 frames.

PATH-TRACE: Plain text can be transmitted by selecting PATH-TRACE. 15 bytes (i.e. a selected byte in 15 frames, ideally the J1 byte) can be filled. A check sum is formed from these 15 bytes which is inserted in the preceding frames as a 16th byte. This can be monitored on the results page by selecting "64 byte sequence" from the "Result Format" sub-menu.

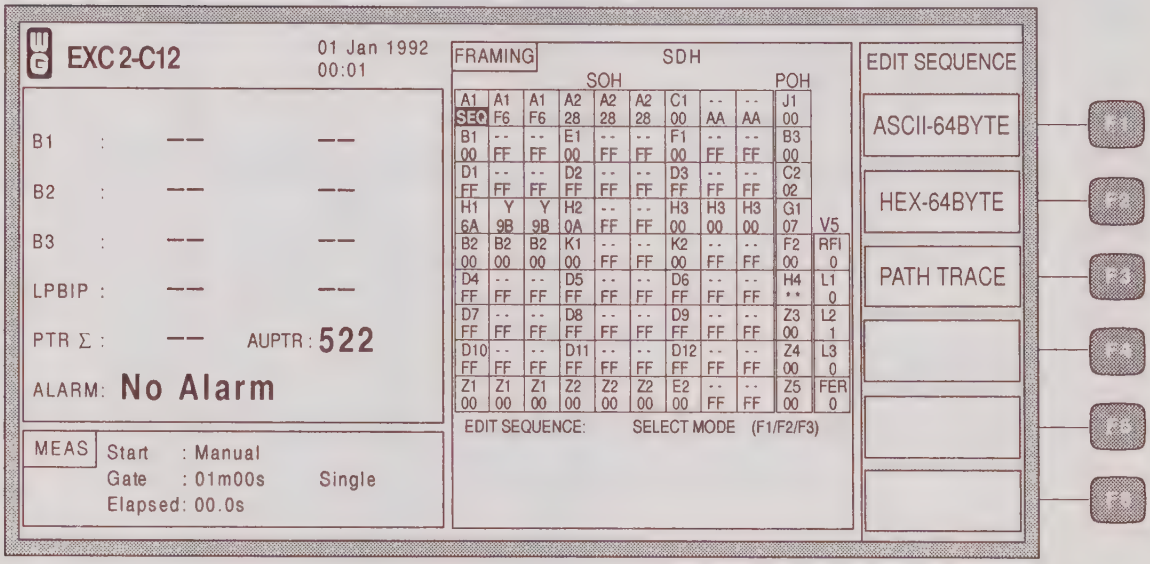


Fig. 3-28 "SOH/POH edit" after selecting F2 "Byte with Sequence"

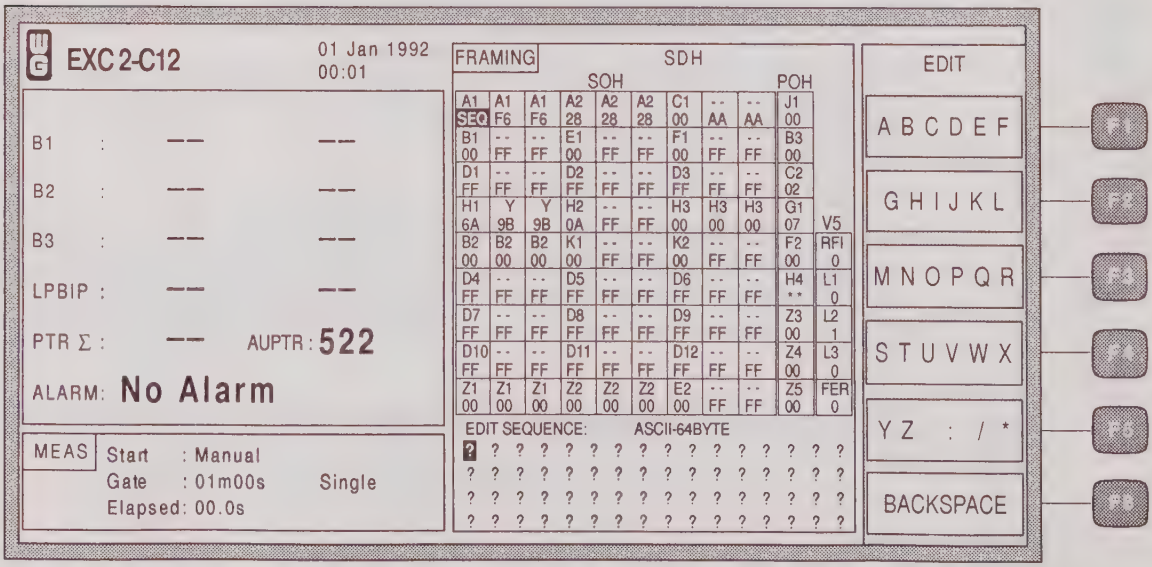


Fig. 3-29 "SOH/POH edit" after selecting F2 "Byte with Sequence" followed by "ASCII-64BYTE"

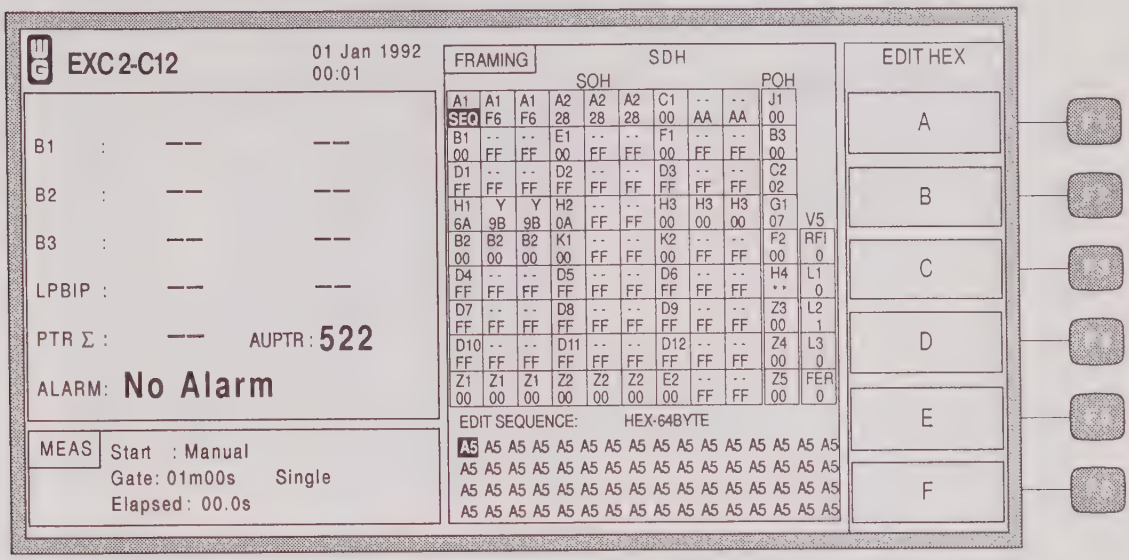


Fig. 3-30 "SOH/POH edit" after selecting F2 "Byte with Sequence" followed by "HEX-64BYTE"

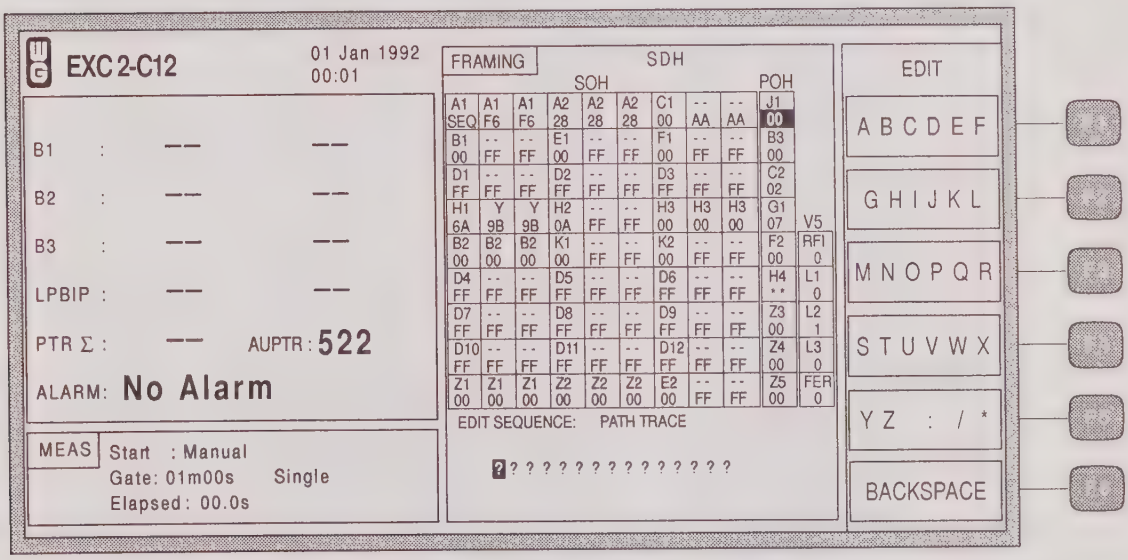


Fig. 3-31 "SOH/POH edit" after selecting F2 "Byte with Sequence" followed by F3 "PATH-TRACE"

F3 and F4 are used to fill the selected byte with the TX pattern or with the pattern present on the V.11 interface.

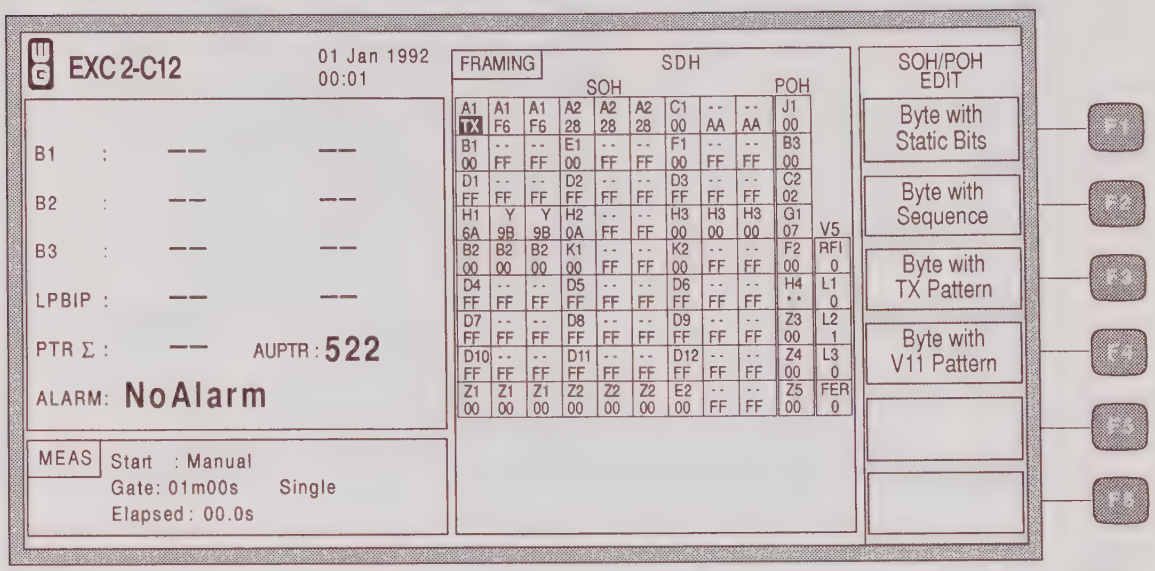


Fig. 3-32 "SOH/POH edit" after selecting F3 "Byte with TX pattern"

The following parameters can be altered for the RX side:

Descrambler

The descrambler can be activated/deactivated. The descrambling procedure uses the 7 bit polynomial specified by ITU-T Rec. G.709.

Tributary

As with the TX tributary, an RX tributary between 1 and 63 can also be selected.

64 byte sequence

The byte (row/column) selected here is displayed with its hexadecimal and ASCII values on the results page.

SOH/POH evaluation

The bytes in the SOH and POH to be evaluated by the counter or to be passed on to the V.11 interface are selected here (see Fig. 3-33).

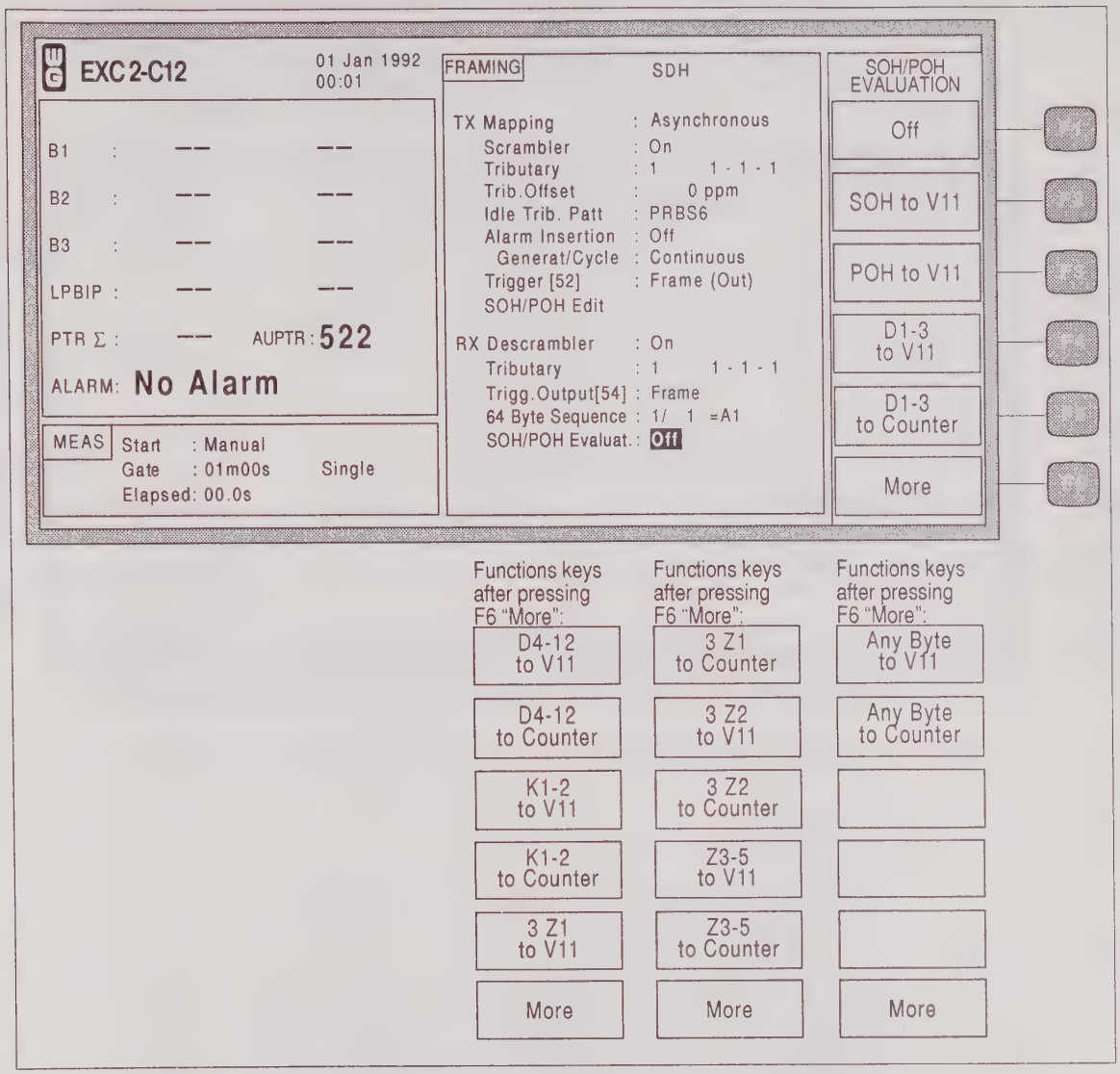


Fig. 3-33 "TX/RX Frame" menu page: SOH/POH evaluation facilities

3.3.5.3 TX/RX Frame" menu for "SDH EXCHANGE 140-C4" application

The menu page can be switched between SDH and PDH framing. The "PDH framing" page is identical to the "PDH EXCHANGE" application menu (section 3.3.5.5).

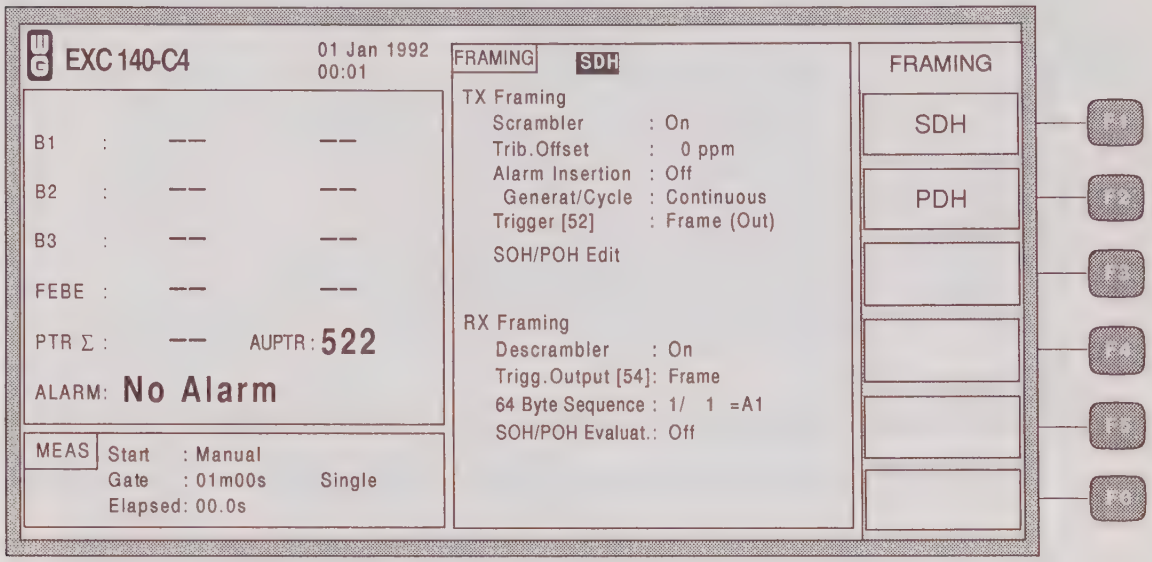


Fig. 3-34 Example of "TX/RX Frame" menu for "SDH EXCHANGE 140-C4" application

The "TX/RX Frame" menu gives access to the following functions (figure 3-34):

SDH framing

- Switch scrambler off/on (default = on)
- Offset frame tributary
- Transmit selected alarms (e.g. LOS, LOF, AU-LOP, AU-AIS, etc.) and select alarm generation and cycle
- Select trigger to socket [52]
- Edit TX SOH/POH bytes (except B1, B2 and B3 bytes), see section 3.3.5.2
  Alter hexadecimal/binary value of one or more bytes statically
  Occupy one byte over 64 frames with an ASCII or hexadecimal sequence
  Dynamically occupy a byte or group of bytes with a TX pattern or a pattern via the V.11 interface

- Switch descrambler off/on (default = on)
- Select trigger to output [54]
- Receiver: Select SOH/POH byte from which a sequence from 64 consecutive frames is to be stored (can be shown as hexadecimal and ASCII values in the left-hand half of the display using the "Result Format" menu)
- Select SOH, POH or byte groups from the SOH to be evaluated or passed on to the V.11 interface

The possible selections for the parameters given above are shown in section 3.1.4 "Menu trees" under "TX/RX frame", and section 3.3.5.2.

Note: The "TX/RX frame" menus for all other SDH EXCHANGE applications except 2-C12 correspond to the above illustration.

3.3.5.4 "TX/RX Frame" menu for "SDH EXCHANGE 34-C3" application

The "TX/RX Frame" menu for the "SDH EXCHANGE 34-C3" application is the same as the "SDH EXCHANGE 140-C4" application menu.

The VC-3 POH is however added to the graphics display of the SOH and POH (see figure 3-35)

.

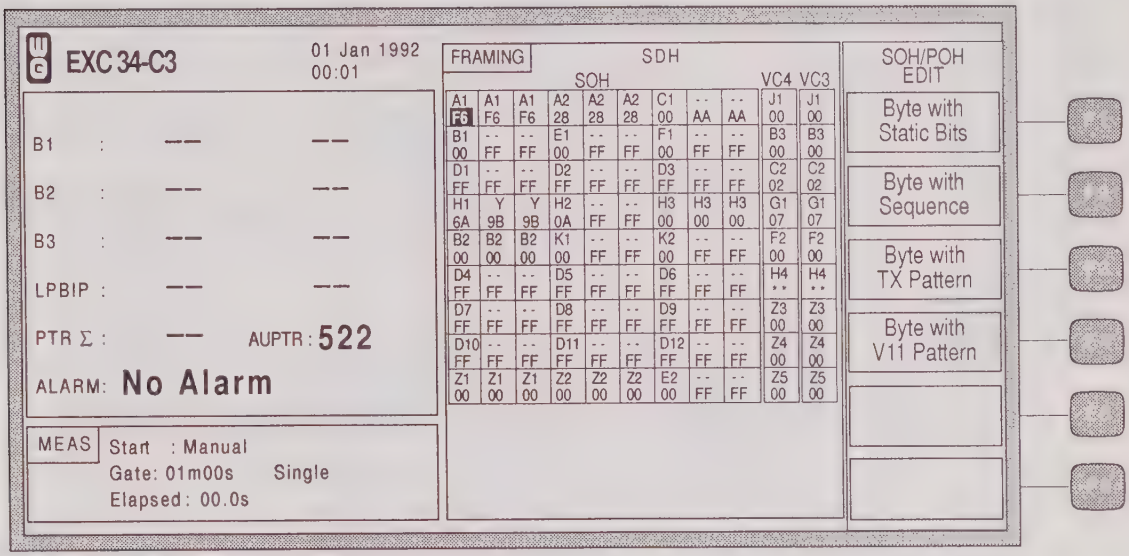


Fig. 3-35 Example of "TX/RX Frame" menu for "SDH EXCHANGE 34-C3" application

3.3.5.5 "TX/RX Frame" menu for "PDH EXCHANGE" applications

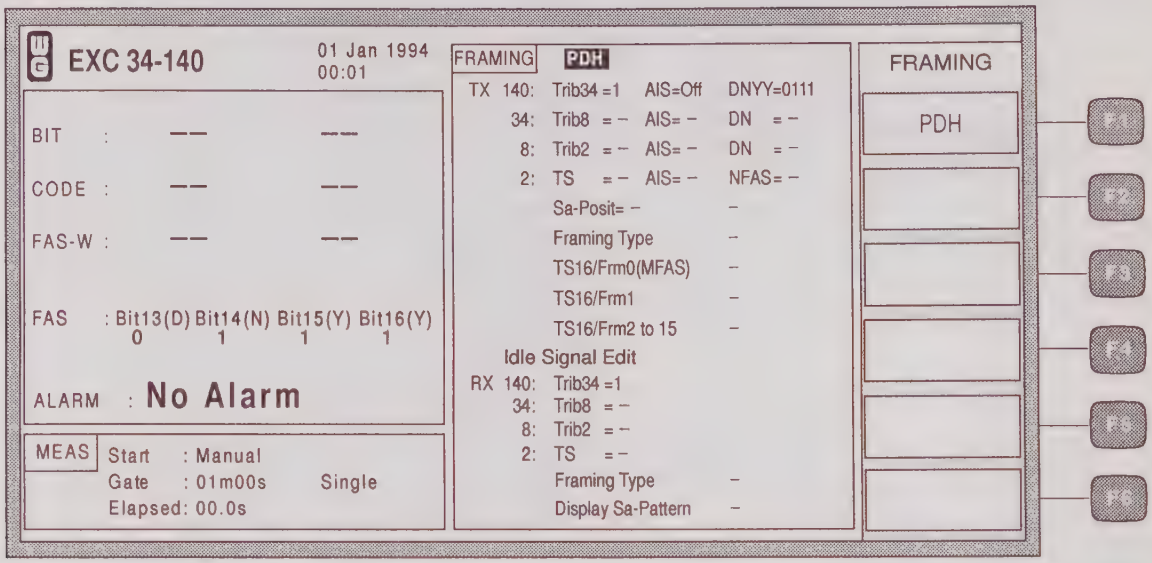


Fig. 3-36 Example of "TX/RX Frame" menu for "PDH EXCHANGE 34-140" application

The following functions can be selected from the "TX/RX Frame" menu (see figure 3-36):

TX:

- Activate frame AIS in the individual hierarchy levels
- Set the tributaries for the individual hierarchy levels
- Alter the frame bits (DNYY for140 Mbit/s, DN for all other hierarchy levels)
- For 2 Mbit/s framed: Set the Sa bit position and Sa pattern, select frame type (PCM30, PCM31, with/without CRC), set timeslot 16 pattern in frames 0, 1 and 2 to 15
- Idle signal edit: Select 64K pattern, set CRC in 2M on/off, set NFAS in 2M, set AIS on/off in the individual hierarchy levels, set frame bits DN in 8/34M (see figure 3-37).

RX:

- Select frame tributaries for the individual hierarchy levels
- For 2 Mbit/s framed: Set frame type (PCM30, PCM31, with/without CRC), select display of pattern for one S_a bit (S_a4 - S_a8). The pattern is shown additionally under NFAS in the left-hand half of the display (see figure 3-38).

Note: The possible entries for the PDH framing page also depend on the application. Only those parameters which can be altered for the selected application will be available for selection. All other parameters can not be accessed by the cursor and are indicated by a blank hyphen "–".

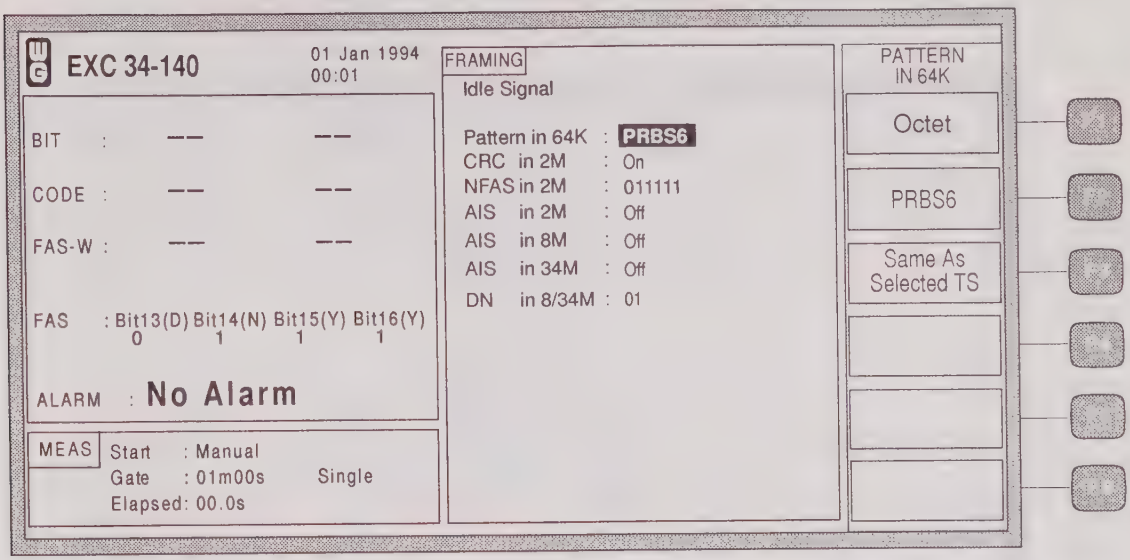


Fig. 3-37 Display after selecting "Idle Signal Edit" in the "TX/RX Frame" menu

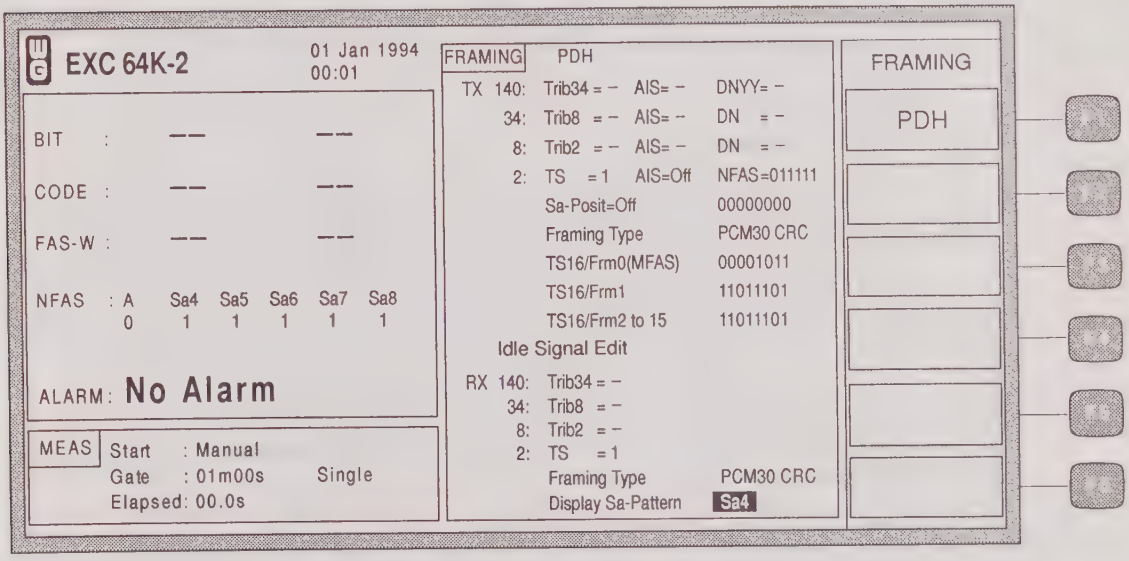

EXC 64K-2
01 Jan 1994
00:01
BIT : —— ——
CODE : —— ——
FAS-W : —— ——
NFAS : A Sa4 Sa5 Sa6 Sa7 Sa8
0 1 1 1 1 1
ALARM: No Alarm
MEAS Start : Manual
Gate : 01m00s Single
Elapsed: 00.0s
FRAMING PDH
TX 140: Trib34 = – AIS= – DNYY= –
34: Trib8 = – AIS= – DN = –
8: Trib2 = – AIS= – DN = –
2: TS = 1 AIS=Off NFAS=011111
Sa-Posit=Off 00000000
Framing Type PCM30 CRC
TS16/Frm0(MFAS) 00001011
TS16/Frm1 11011101
TS16/Frm2 to 15 11011101
Idle Signal Edit
RX 140: Trib34 = –
34: Trib8 = –
8: Trib2 = –
2: TS = 1
Framing Type PCM30 CRC
Display Sa-Pattern Sa4
FRAMING
PDH

Fig. 3-38 Display after selecting "Pattern display: Sa4" in the "TX/RX Frame" menu

Note: The "PDH Framing" menu page discussed under the "PDH EXCHANGE" applications applies to all other applications except for "UNFRAMED".

3.3.5.6 "TX/RX Frame" menu for "SDH MUX" applications

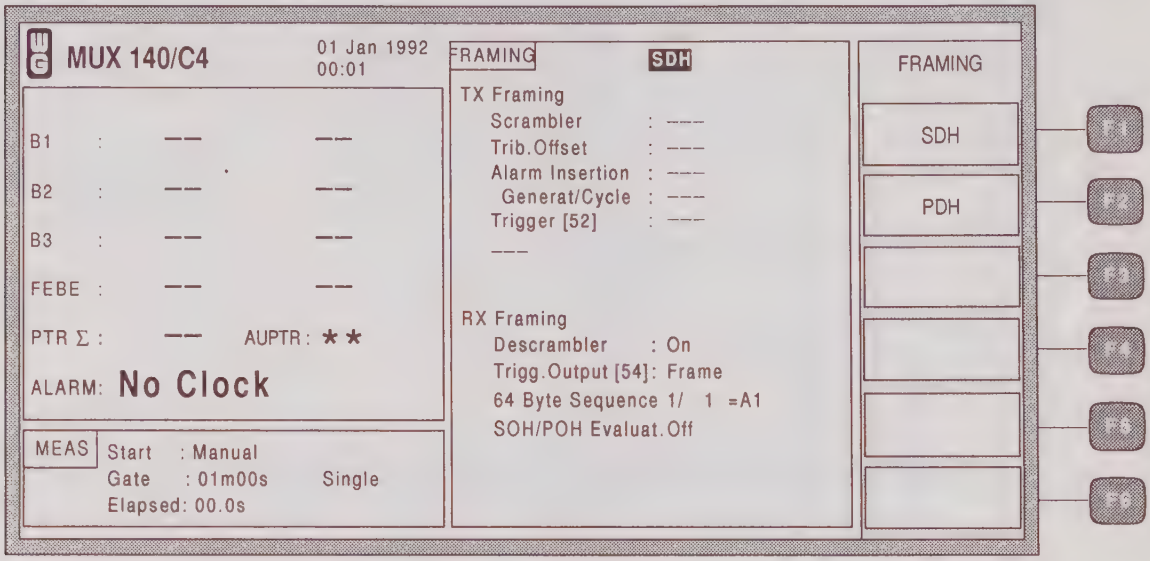


Fig. 3-39 Example display of "TX/RX Frame" menu, "SDH MUX 140/C4", short-circuit mode

The following functions are performed via the "TX/RX menu" (figure 3-39):

RX framing (SDH)

- Switch descrambler on/off
- Select trigger at output [54]
- Receiver: Select SOH/POH byte from which a sequence from 64 consecutive frames is to be stored (can be displayed in hexadecimal and ASCII values in the left-hand half of the display via the "Result Format" menu).
- Determine the SOH, POH or byte groups from the SOH which are to be evaluated or fed to the V.11 interface.

TX framing (PDH)

The TX side framing can be set for the individual PDH hierarchies as described under "PDH EXCHANGE" (section 3.3.5.5).

RX framing (PDH)

The RX side framing can be set for the individual PDH hierarchies as described under "PDH EXCHANGE" (section 3.3.5.5).

3.3.5.7 "TX/RX Frame" menu for "SDH DEMUX" applications

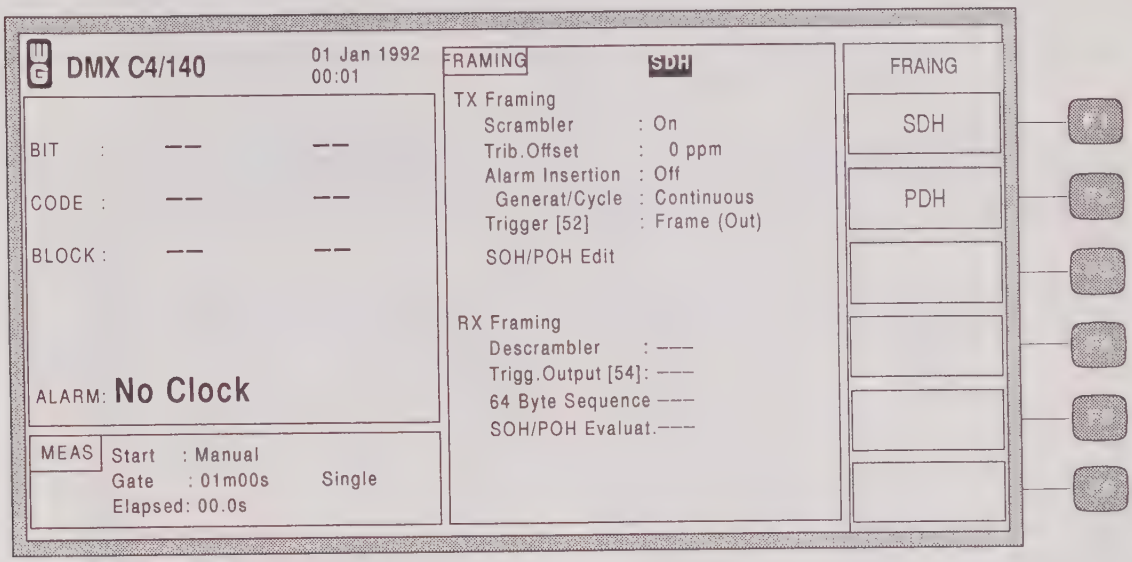


Fig. 3-40 Example display of "TX/RX Frame" menu "SDH DEMUX C4/140", short-circuit mode

The following functions are performed via the "TX/RX menu" (figure 3-40):

TX framing (SDH)

- Switch scrambler on/off
- Offset frame tributary
- Transmit certain alarms, e.g. LOS, LOF, AU-LOP, AU-AIS etc.
  Select alarm generation and alarm cycle
- Select trigger to socket [52]
- Edit TX side SOH/POH bytes (except B1, B2, B3 bytes), see section 3.3.5.2
- Statically alter the hexadecimal/binary value of one or more bytes
  - Fill a byte in 64 frames with an ASCII or hex sequence
  - Fill one byte or a group of bytes with a dynamically variable TX pattern or a pattern fom the V.11 interface

TX framing (PDH)

The TX side framing can be set for the individual PDH hierarchies as described under "PDH EXCHANGE" (section 3.3.5.5).

RX framing (PDH)

The RX side framing can be set for the individual PDH hierarchies as described under "PDH EXCHANGE" (section 3.3.5.5).

The available selections for the parameters mentioned above are found in section 3.1.4 "Menu trees" under "TX/RX Frame".

3.3.6 "Measurement" menu

To open the "Measurement" menu, start from the main menu page. If a menu other than the main menu is displayed, press the MAIN MENU key [15].

Now press key [4]. The "Measurement" menu is displayed in the right-hand half of the display instead of the RX and TX windows.

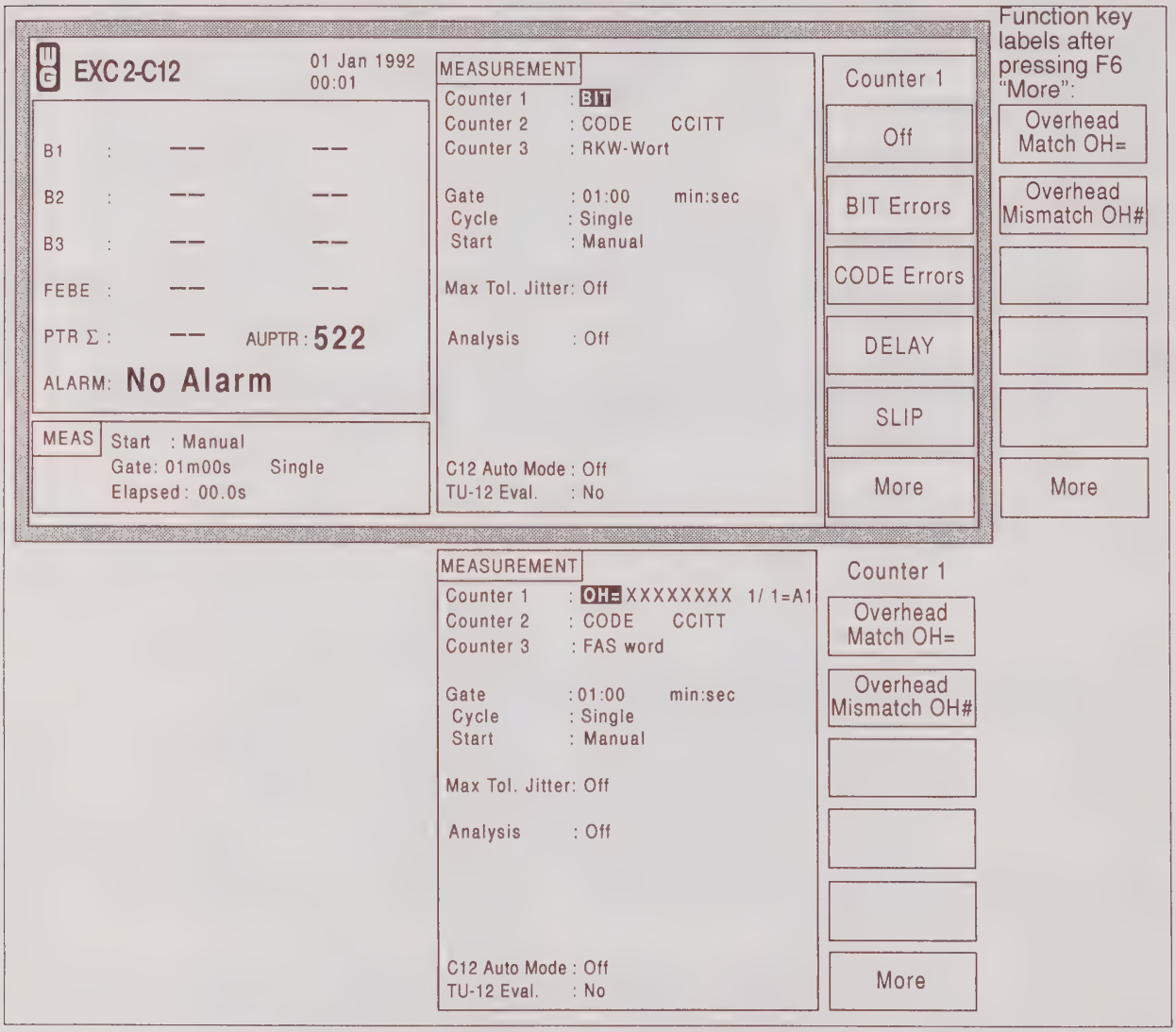


Fig. 3-41 Example of "Measurement" menu display for "SDH EXCHANGE 2-C12" application

The "Measurement" menu gives access to the following functions:

- Select the events to be registered by counters 1 to 3
- Select the gate time
- Select the measurement cycle
- Select manual or timer start
- Perform automatic Max. Tol. Jitter (MTJ) measurement (see 3.3.6.1)

- Perform G.821 analysis (see section 3.3.6.2)
  Select various additional printout intervals for the G.821 measurement (Add. Intv. 1 - 3)
  Set SES threshold
  Set DM threshold
  Set Alarm=SES
  Set MUX divider
- Perform G.826 analysis (option, see section 3.3.6.3)
- C-12 Auto Mode (for STM-1 C-12 only)
  Check tributary scanning, or
  Start tributary search to locate TX pattern in the tributaries.
- Activate/deactivate TU-12 evaluation (yes/no, for STM-1 C-12 only)

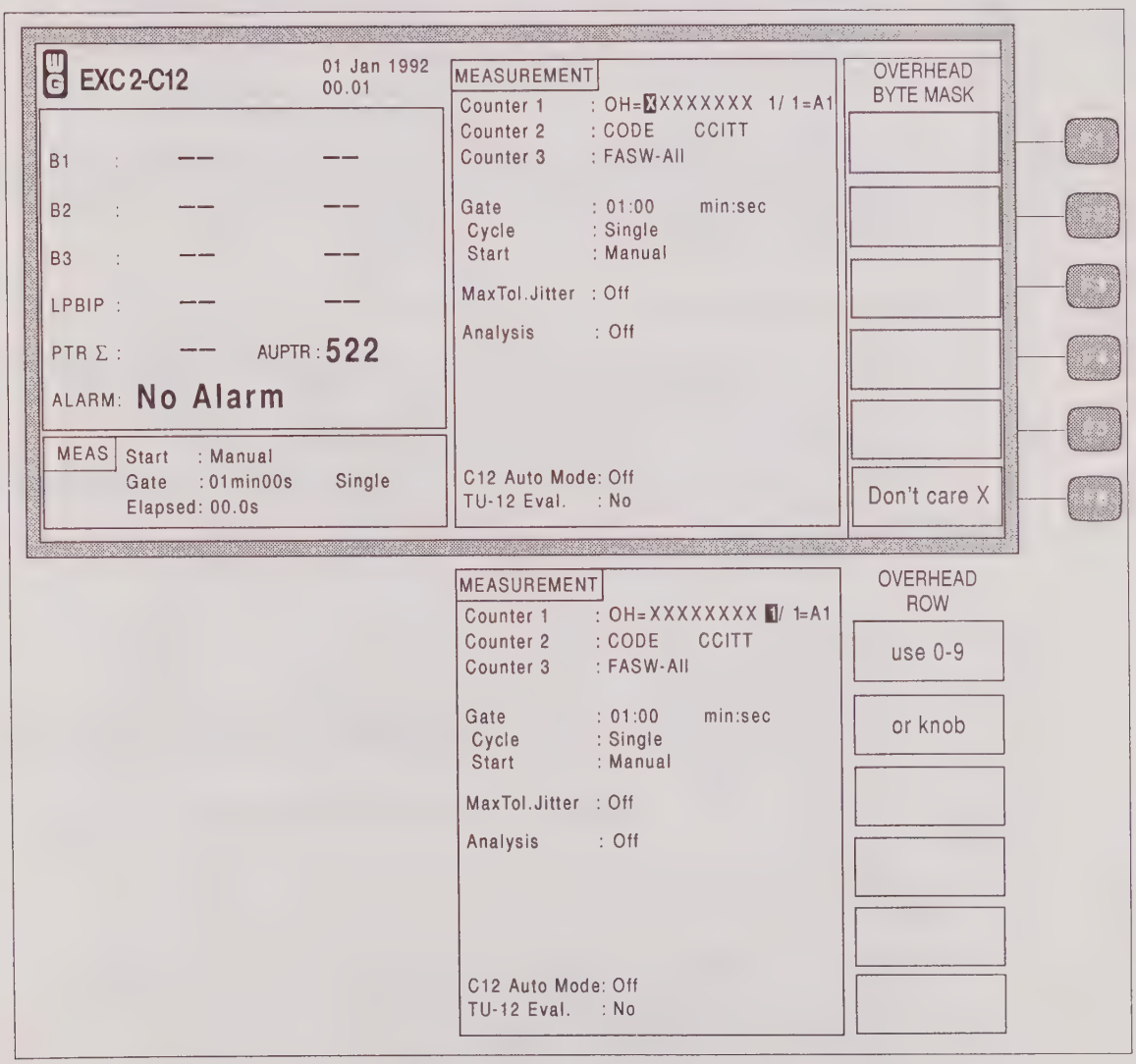


Fig. 3-42 "Measurement" menu, counter 1 assignment "Overhead match OH="

Counter 1 to 3

Various error events can be selected for the counters 1 to 3. The counter assignments are shown in the left-hand half of the display. If a new selection is made, this is shown immediately against the relevant counter in the display.

Note: In the "SDH EXCHANGE" and "SDH MUX" applications, the fixed counters for the B1, B2 and B3 parity errors and for FEBE (C4), LP-BIP (C12), AU pointers and pointer count are shown in the left-hand half of the display instead of counters 1 to 3.

Default settings:

1 "UNFRAMED", "PDH DEMUX" applications
  Counter 1: BIT
  Counter 2: CODE
  Counter 3: BLOCK
2 "SDH EXCHANGE", "SDH MUX" applications
  Counter 1: BIT
  Counter 2: CODE
  Counter 3: All FAS-W
3 "SDH DEMUX", "PDH EXCHANGE", "PDH MUX", "FRAMED PATTERN" applications
  Counter 1: BIT
  Counter 2: CODE
  Counter 3: FAS-W

Overhead match

Counter 1 can be assigned a byte mask for any overhead byte other than the parity bytes (see figure 3-42). You can select whether the counter is to register the frames in which the selected byte is the same as the byte mask (Overhead Match OH=) or the frames in which the selected byte is not the same as the byte mask (Overhead Mismatch OH#).

The result of the overhead comparison can be displayed on the results page (left-hand window) if "All Results" is selected in the "Result Format" menu (Main Menu, F5).

Setting the measurement parameters

The parameters

- Gate Time
- Measurement Cycle
- Measurement Start Mode

shown in the lower window (MEAS) on the left-hand side of the display can be altered in the "Measurement" menu.

The **gate time** interval range is selected using function keys [3] to [6]:

- Days:Hours [3]
- Hours:Mins [4]
- Mins:Secs [5] (default setting)
- Seconds [6]

The gate time required is entered using the numeric keys or the rotary control.

The following **measurement cycles** can be selected:

- Single measurement [1] (default setting)
- x N [2] (N can be any whole number from 1 to 99)
- Repetitive [3]

The measurement **start** can be triggered by

- Timer switch [1] or
- Manual trigger [2] (default setting)

If the measurement is to be timer controlled [1], the day, month and time (e.g. 09 Mar 15:10) can be entered using the numeric keys or the rotary control.

These changes in the measurement parameters are immediately transferred to the MEAS window as they are made.

Example:

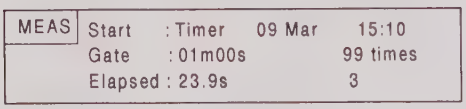


Fig. 3-43 "MEAS" window showing measurement parameters altered during the course of a measurement

In the example shown in figure 3-43, the following settings were made:

- Start of measurement timer controlled (Timer); start on March 9th at 15:10
- Gate time per measurement: 1 minute
- Number of measurement cycles: 99
- Elapsed time of current measurement: 23.9 seconds
- Number of measurement cycles completed: 3 (of 99)

Note: Measurements are **not** interrupted if the instrument is switched to standby mode using the standby switch (display off, yellow STANDBY LED on, red indicator showing in standby switch). If the a.c. line switch [H] is left in the on position, the test circuit will continue to be supplied with current with the instrument in standby mode.

C-12 Auto Mode (for SDH EXCHANGE 2-C12, SDH MUX 2/C12, SDH MUX 2-34/C1 applications only)

The C-12 Auto Mode comprises two functions (see figures 3-44 and 3-45):

1 Tributary scan
This function checks the through-switching of tributaries from the receiver to the transmitter.

2 Tributary search
The RX tributaries are checked for the presence of the TX pattern.

After selecting one of the two functions, the left-hand display window shows the 63 x 2 Mbit/s tributaries in graphic form instead of the list of counters.

The function is executed by pressing the START key.

If the result of the test is positive (through-switching is present or TX pattern located) the message "ok" appears under the tributary number.

If the result of the test is negative, the message '##', is shown under the tributary number (e.g. as shown for tributary 61 in figure 3-45).

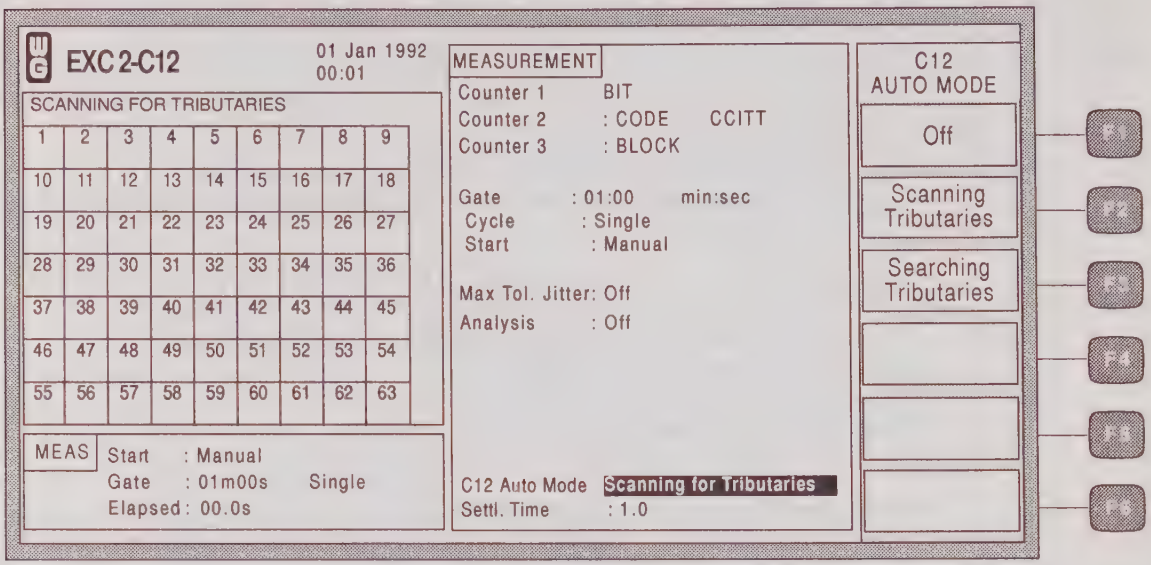


Fig. 3-44 "Measurement" menu after selecting C-12 auto mode "Scanning Tributaries"t

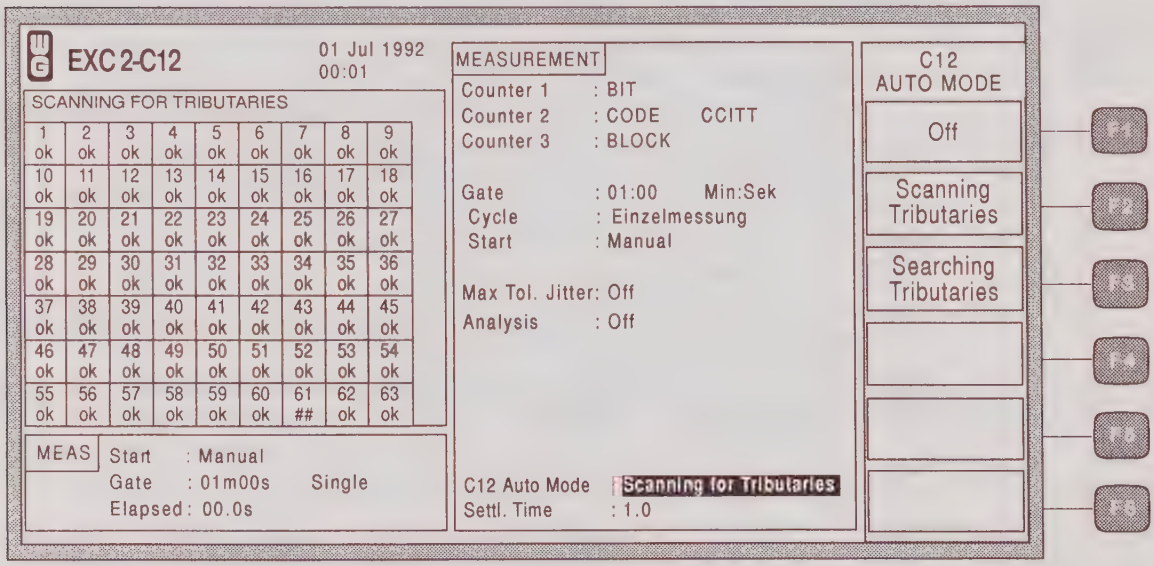

EXC 2-C12
01 Jul 1992
00:01
SCANNING FOR TRIBUTARIES
1 ok 2 ok 3 ok 4 ok 5 ok 6 ok 7 ok 8 ok 9 ok
10 ok 11 ok 12 ok 13 ok 14 ok 15 ok 16 ok 17 ok 18 ok
19 ok 20 ok 21 ok 22 ok 23 ok 24 ok 25 ok 26 ok 27 ok
28 ok 29 ok 30 ok 31 ok 32 ok 33 ok 34 ok 35 ok 36 ok
37 ok 38 ok 39 ok 40 ok 41 ok 42 ok 43 ok 44 ok 45 ok
46 ok 47 ok 48 ok 49 ok 50 ok 51 ok 52 ok 53 ok 54 ok
55 ok 56 ok 57 ok 58 ok 59 ok 60 ok 61 ## 62 ok 63 ok
MEAS
Start : Manual
Gate : 01m00s Single
Elapsed: 00.0s
MEASUREMENT
Counter 1 : BIT
Counter 2 : CODE CCITT
Counter 3 : BLOCK
Gate : 01:00 Min:Sek
Cycle : Einzelmessung
Start : Manual
Max Tol. Jitter: Off
Analysis : Off
C12 Auto Mode Scanning for Tributaries
Settl. Time : 1.0
C12
AUTO MODE
Off
Scanning Tributaries
Searching Tributaries
F1
F2
F3
F4
F5
F6

Fig. 3-45 "Measurement" menu after starting C-12 auto mode "Scanning Tributaries"

The graphic display for the "Searching Tributaries" function corresponds to figures 3-44 and 3-45.

TU-12 evaluation (for SDH EXCHANGE 2-C12, SDH MUX 2/C12 applications only)

You can select whether to evaluate the TU-12 pointer operations or not from the "Measurements" menu (selection "YES"/"NO").
The default setting when the application is selected is "TU-12 Eval.: = No". If "Yes" is selected, the "LP-BIP" counter in the left-hand display window is replaced with the "TUPTR" counter.

3.3.6.1 Automatic maximum tolerance to jitter measurement (MTJ)

The default setting for the MTJ measurement is OFF (F1). If set to ON (F2), the parameters required for the MTJ measurement which can be altered are displayed in the right-hand half of the screen.

At the same time, the default settings of the counters are altered (only counter 2 assigned: BIT) and the gate time is preset (interval range: seconds; gate time: 1 second).

The left-hand half of the display shows a table instead of the counters. The frequencies at which the MTJ measurements are made (fixed logarithmically spaced frequencies or 10 user-defined frequencies) and the resulting maximum amplitude values are entered in the table as the measurement proceeds. The following figure shows the display after pressing function key F2 "MTJ ON".

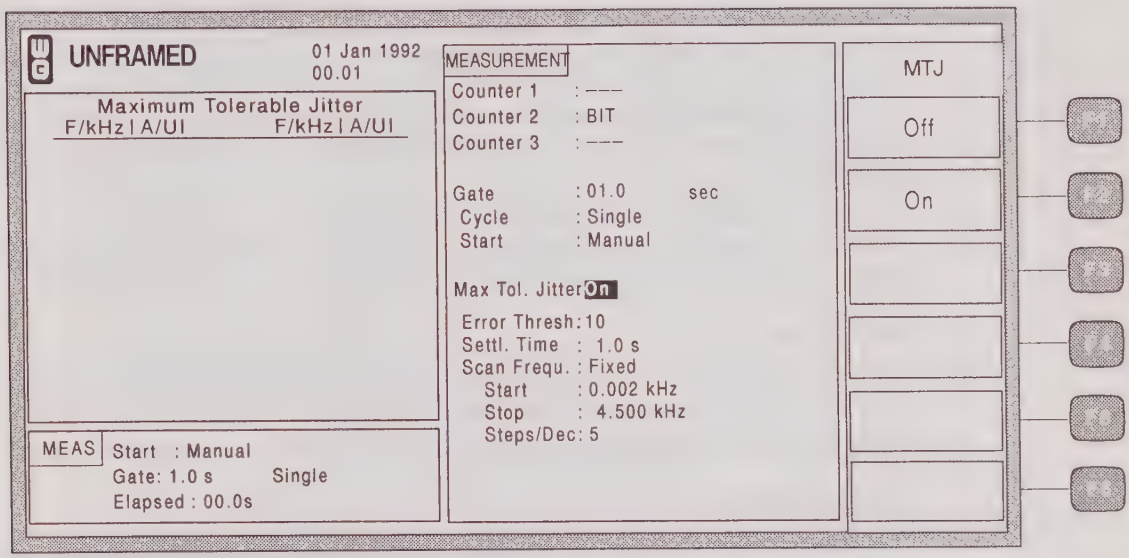


Fig. 3-46 "Measurements" menu after activating MTJ measurement

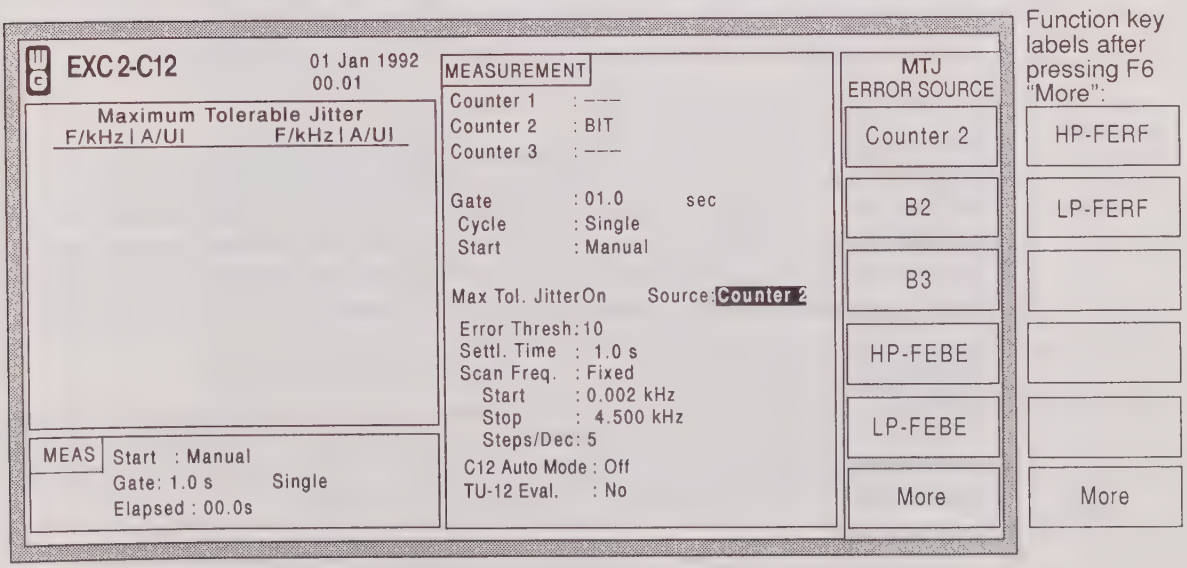


Fig. 3-47 "Measurements" menu, MTJ error source display

Error source (counter 2)

Two error sources can be selected via counter 2:

1 Internal source: Select between BIT, CODE and CRC Word errors
2 External source: EXT [49]

One of the following error events (for the fixed counters) can be selected as error source for the MTJ measurement instead of the counter 2 error type for applications involving SDH signals (see figure 3-47):

- B2, B3, HP-FEBE, HP-FERF (for STM-1 C4)
- B2, B3, HP-FEBE, HP-FERF, LP-B3 (for STM-1 C3)
- B2, B3, HP-FEBE, LP-FEBE, HP-FERF, LP-FERF (for STM-1 C12)

Error threshold

After starting the measurement by pressing START [10], the jitter amplitude of the digital signal at the lower corner frequency will be increased automatically until the error meter (on counter 2) registers more errors than the preset threshold value (default setting: 10 errors). The tolerance to jitter value output as the result for this frequency is the value which lies one search increment below this.

Any threshold between 0 and 999 errors can be set.

The following events are considered as exceeding the threshold: Loss of synchronization (no pattern, no frame), AIS and micro-interrupt.

Settling time

The settling time is the time delay between successive jitter measurements which is provided to allow the clock recovery circuits time to resynchronize.

A time from 0.1 to 99.9 seconds can be set.

Jitter frequency

The jitter frequencies at which measurements are made can be specified in two ways:

– As a logarithmically spaced fixed sequence between given start and stop frequencies ([1] Fixed)

– As 10 freely-defined frequencies ([2], User)

The parameter **Steps/decade** determines the number of frequencies at which measurements are made per decade. Any whole number between 2 and 9 can be selected.

Start/Stop MTJ measurement

Once the parameters have been set as required, the MTJ measurement is started at the lower corner frequency by pressing the START key [10]. The measurement then proceeds automatically until the measurement at the upper corner frequency (STOP frequency or highest user-specified frequency value) has been made, which completes the measurement sequence. The red LED above the STOP key [10] lights up to indicate the end of the measurement.

The MTJ measurement can be stopped prematurely by pressing STOP [10] at any time.

Print mode

Print mode is switched from "Manual" to "Automatic" when the MTJ measurement is activated, so that the results are printed out automatically once the measurement has been started (see figure 3-48). If a printout is not required, the print mode must be reset to "Manual" in the "Printer" menu (MAIN MENU, [6]) **before** the MTJ measurement is started.

When MTJ measurement mode is deactivated, the printer reverts to "Manual" control.

```
SF-60          08 JUN 94
MAX. TOLERABLE  JITTER
TXRX:139264kb/s        PRS23
FRAME : EXC 34-140
THRESHLD BIT-ER :>  10
DELAY:  1.0s  GATE  : 1.0s

14:40:59                START
J-FREQ./kHz  |   J-AMPL./UI
    10.00    |     20.0    *
    20.0     |     20.0    *
    50.0     |     20.0    *
   100.0     |     10.0    *
   200.0     |      5.0    *
   500.0     |      2.00   *
  1000.0     |      2.00   *
  2000.0     |      1.27
  3000.0     |      0.84
```

Fig. 3-48 MTJ measurement printout, short-circuit measurement of SF-60

Notes on the printout (figure 3-48, MTJ measurement printout, short-circuit measurement of SF-60):

Printout header

- SF-60, date: 08 Jun 1994
- Mode: Max. Tol. Jitter
- Bit rate for TX/RX, pattern:
  TXRX: 139264 kbit/s PRBS23
- Application selected, TX and RX channel (framed signals):
  FRAMED (framed error test) EXC 34-140
- Error threshold for selected error type:
  THRESH BIT ERR: > 10
- Settling time, gate time
  SETTL.: 1.0s GATE TIME: 1.0 s

Results table

- Start time
- Pairs of values: Jitter frequency (kHz) and Jitter amplitude (UI)

An asterisk (*) after the result indicates that the transmit jitter of the SF-60 reached the upper limit (20 UI) or that the frequency span is too large for the selected bit rate.

3.3.6.2 Evaluation to ITU-T G.821

The default setting of the analysis (to G.821 or G.826) parameter is OFF ([1]). Press function key [2] to activate G.821 analysis. The evaluation refers to events counted on one of the counters 1, 2 or 3.

One of the following events can be selected for the G.821 evaluation instead of the events counted by counters 1 to 3:

- B1, B2, HP-FEBE, FAS-W 140M, FAS-W STM (STM-1 C-4)
- B1, B2, B3, HP-FEBE, FAS-W 34M, FAS-W STM, LP-B3 (STM-1 C3)
- B1, B2, HP-FEBE, LP-FEBE, LP-BIP (STM-1 C-12)

Other parameters which can be set or selected are:

- Set additional printout intervals
- Set SES threshold
- Set DM threshold
- Activate Alarm=SES
- Activate MUX divider

The results of the G.821 evaluation are stored in a separate memory and can be displayed using the "Result Format" menu (MAIN MENU, [5]).

As with MTJ mode, **print mode** is switched from "Manual" to "Automatic" when the G.821 measurement is activated, so that the results are printed out automatically at the end of each interval and at the end of the measurement.

Print intervals

To allow more exact analysis of the G.821 results, it is a good idea to print out the current results of a continuing G.821 measurement at regular intervals during the measurement.

Three different printout intervals can be defined for this purpose:

- Add.Intv.1
  [1] Off
  [2] 5 minutes
  [3] 10 minutes
  [4] 15 minutes
  [5] 30 minutes
- Add.Intv.2
  [1] Off
  [2] 1 hour
  [3] 2 hours
  [4] 4 hours
  [5] 8 hours
- Add.Intv.3
  [1] Off
  [2] 24 hours

At the end of each selected print interval, the overall result and the results occurring within the last interval are printed out automatically, as absolute error counts and error rates.

SES threshold

Error rate values between 1 x 10-5 and 1 x 10-2 can be set as the threshold for determining severely errored seconds (SES).

The default value for SES threshold is the standard ITU-T value of 1 x 10-3.

- Key functions for SES threshold parameter:
  [1] 1 E-2
  [2] CCITT 1 E-3
  [3] 1 E-4
  [4] 1 E-5

A single or repetitive loss of synchronization for a framed signal within a given second is also counted as a SES (see also alarm=SES).

DM threshold

Error rate values between 1 x 10-7 and 1 x 10-2 can be set as the threshold for determining degraded minutes (DM).

The default value for DM threshold is the standard ITU-T value of 1 x 10-6

- Key functions for DM threshold parameter:
  [1] 1 E-2
  [2] 1 E-3
  [3] 1 E-4
  [4] 1 E-5
  [5] CCITT 1 E-6
  [6] 1 E-7

Alarm=SES

If an alarm occurs during a G.821 evaluation, this can be recorded as a SES in the printout by setting alarm=SES to "Yes" (default value).

MUX divider

As the G.821 evaluation is based on a 64 kbit/s channel, a so-called MUX divider factor is used for digital signals of higher bit rates. This factor indicates how many hypothetical 64 kbit/s channels are contained in the signal under test (bit rate divided by 64 kbit/s).

The number of errors measured in each measurement interval is divided by this factor when the MUX divider is activated, so that the display shows the number of errors occurring in a 64 kbit/s channel.

When the MUX divider is active (= YES), the factor for the current bit rate is set automatically (e.g. 32 for 2048 kbit/s or 1920 for 140 Mbit/s). This factor is not displayed; the display only indicates if the MUX divider is active or not.

Example:
If a G.821 measurement is performed at 2048 kbit/s (MUX divider = 32), and 32 errors are detected in one second, the result indicates one bit error per second per 64 kbit/s channel, i.e. one errored second (ES = 1).

3.3.6.3 Evaluation to ITU-T G.826 (Option BN 3017/00.52)

The SF-60 performs in-service ITU-T Recommendation G.826 analysis only on framed signals.

The evaluation of anomalies and defects in accordance with ITU-T Rec. G.826 is referred to the blocks. The error event calculations are based on this.

The default setting of the "Analysis" parameter in the "Measurement" menu is "Off".

Press function key [3] to select G.826 analysis.

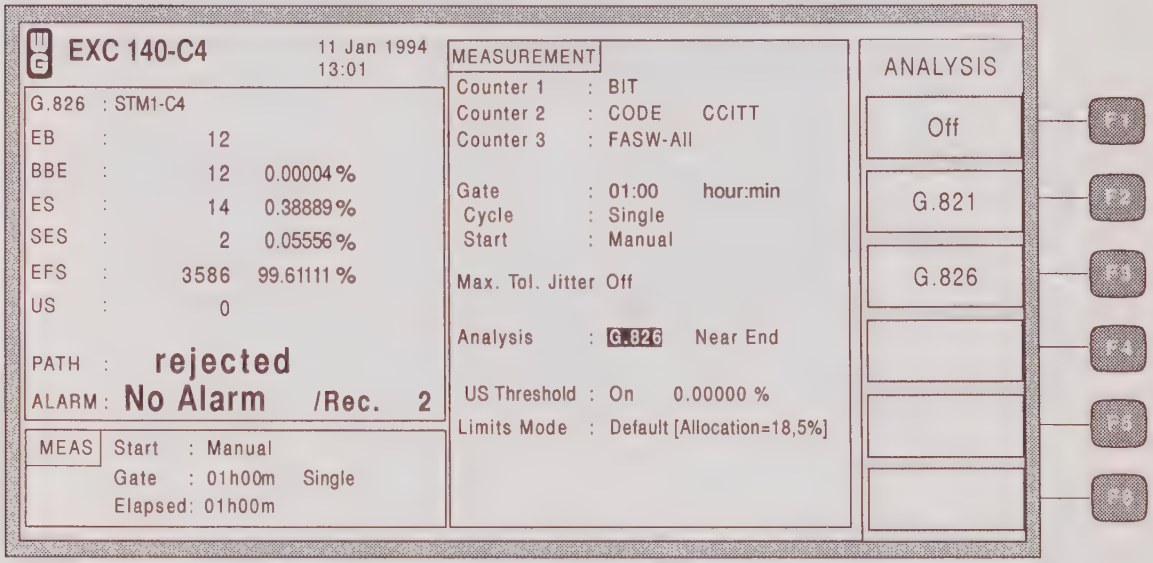


Fig. 3-49 "Measurement" menu after selecting und Durchführen der G.826 analysis

Next to the "Analysis G.826" parameter, it is possible to select between analysis of the forward channel ("Near End") or backward channel ("Far End"). The default setting is "Near End".

Limits mode

The "Limits mode" parameter is used to select the limit conditions to be applied during the G.826 analysis:

1. "Off" (Fig. 3-50)
   No information on the status of the path is given in this mode.

   The SES threshold (≥ 30 % errored blocks in the total number of blocks) is preset depending on the RX frame system and cannot be altered (see Fig. 3-58).

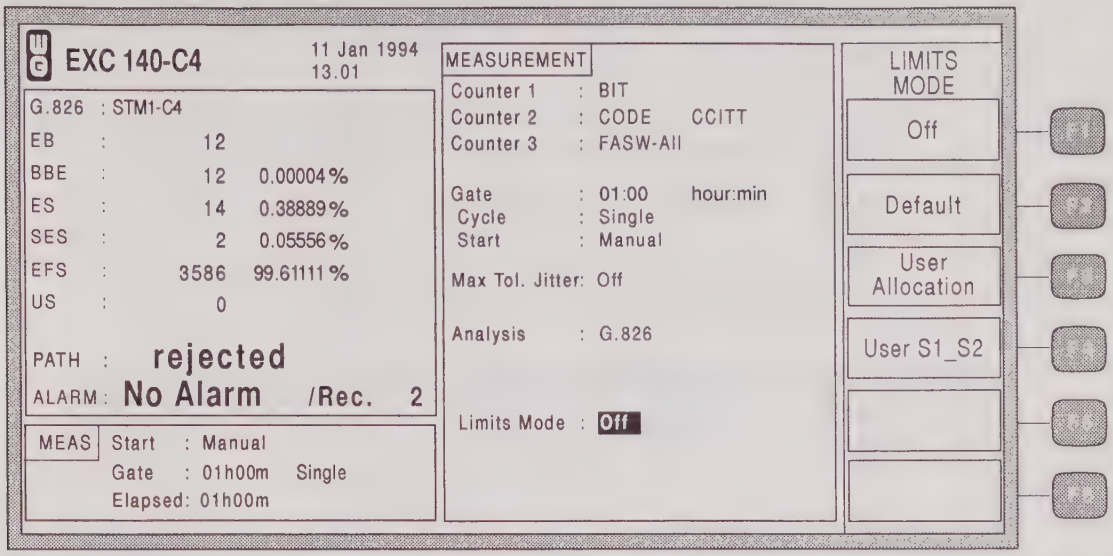


Fig. 3-50 G.826 analysis, Limits mode "Off"

2. "Default" mode (Fig. 3-51)
In this mode, the path is assessed as "ACCEPTED" or "REJECTED". Threshold S1 and the limit values for ES, SES and BBE which apply to it are preset as per Rec. G.826 and cannot be altered.

A path proportion of 18.5 % of the HRX (hypothetical reference path) is used as basis for the calculation.

The SES threshold (≥ 30 % errored blocks in the total number of blocks) is preset depending on the RX frame system and cannot be altered (see Fig. 3-58).

The US (unavailable seconds) threshold above which the path is to be assessed as "REJECTED" can be entered (range 0 to 9.99999%).

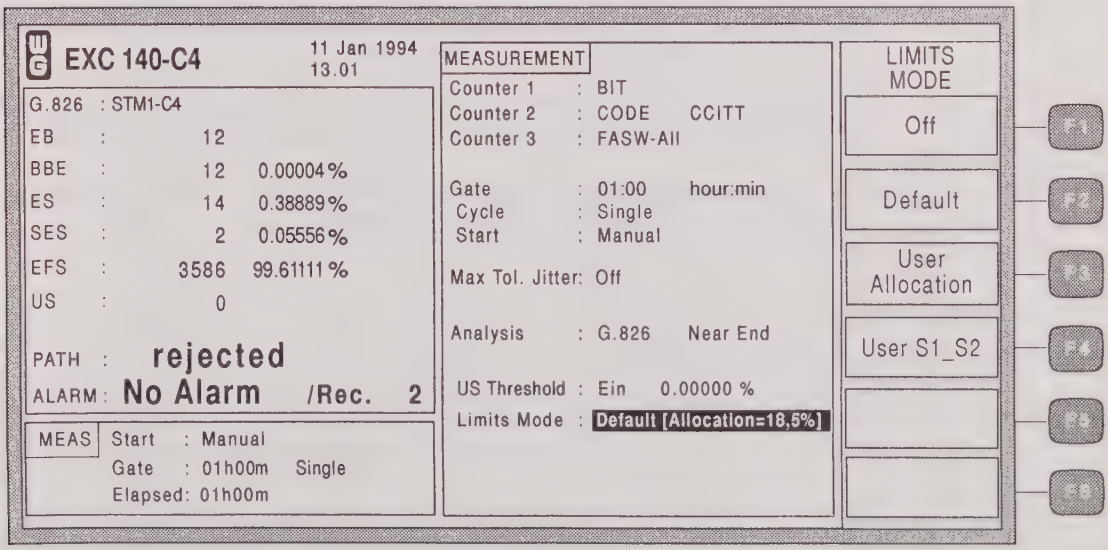


Fig. 3-51 G.826 analysis, "Default" limits mode

3. "User allocation" mode (Fig. 3-52)
   In this mode, the path is assessed as "ACCEPTED" or "REJECTED". Threshold S1 and the limit values for ES, SES and BBE which apply to it are preset as per Rec. G.826 and cannot be altered.

   The SES threshold (≥ 30 % errored blocks in the total number of blocks) is preset depending on the RX frame system and can be altered (parameter "Threshold: SES=").

   The path proportion of the HRX can also be changed (range 0 to 100 %).

   The US (unavailable seconds) threshold above which the path is to be assessed as "REJECTED" can be entered (range 0 to 9.99999%).

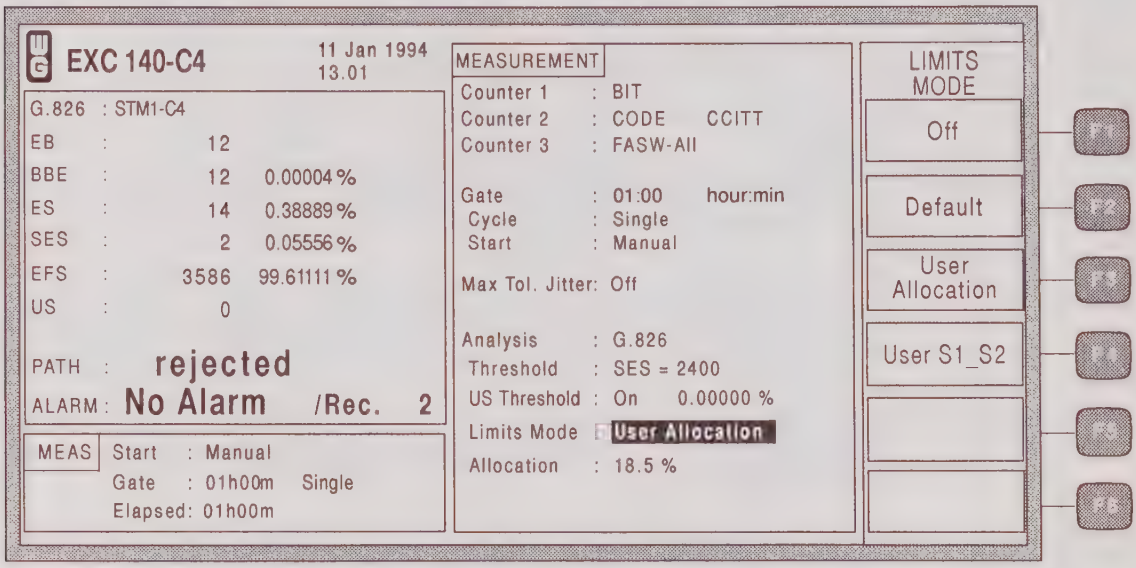


Fig. 3-52 G.826 analysis, "User allocation" limits mode

4. "User S1_S2" mode (Fig. 3-53)
   In this mode, the path is assessed as "ACCEPTED", "UNCERTAIN" or "REJECTED" , with reference to recommendation ITU-T M.2100. Threshold S1 and the limit values for ES, SES and BBE which apply to it can be set by the user.

   The SES threshold (≥ 30 % errored blocks in the total number of blocks) is preset depending on the RX frame system and can be altered (parameter "Threshold: SES=").

   The US (unavailable seconds) threshold above which the path is to be assessed as "REJECTED" can be entered (range 0 to 9.99999%).

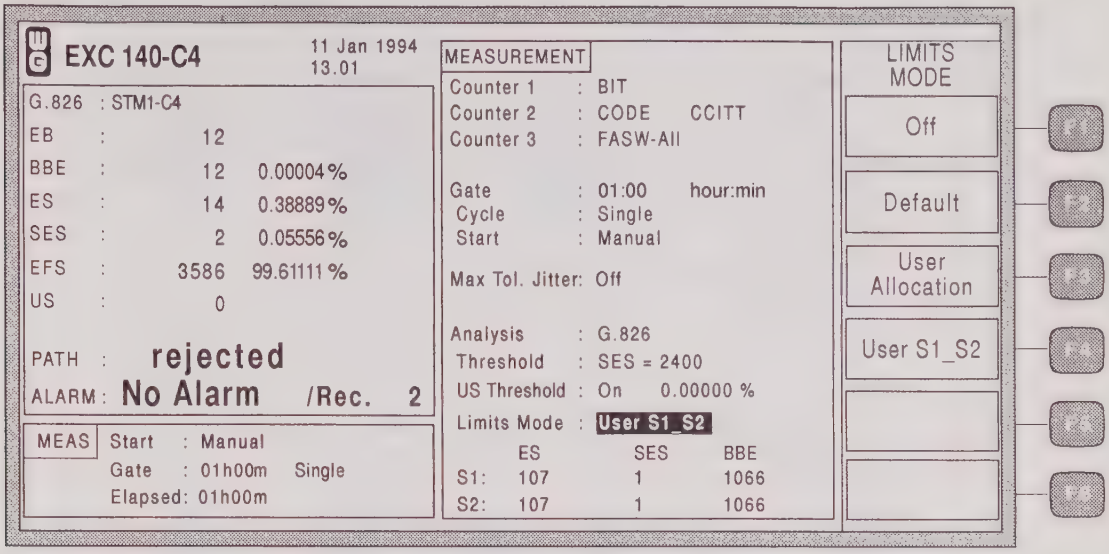


Fig. 3-53 G.826 analysis, "User S1_S2" limits mode

Application areas

1. PDH systems
   Evaluation is in the forward channel only. Evaluation of the highest hierarchy level of multi-stage PDH signals is always made.

2. SDH systems (STM-1 systems)
   Evaluation of overhead parameters (refered to path) is in the forward or the backward channel.

PDH evaluation parameters

Frame system	Anomaly	Defect
2 Mbit/s CRC	CRCW	LOS, LOF, AIS
2 / 8 / 34 / 140 Mbit/s	FASW	LOS, LOF, AIS

Fig. 3-54 Anomalies and defects, PDH systems

SDH evaluation parameters

STM-1 C-4 frame system

Forwards		Backwards	
Anomaly	Defect	Anomaly	Defect
B3	LOS, LOF, MS-AIS, AU-LOP	HP-FEBE	HP-FERF

Fig. 3-55 Anomalies and defects, STM-1 C-4

STM-1 C-3 frame system

Forwards		Backwards	
Anomaly	Defect	Anomaly	Defect
LP-B3	LOS, LOF, MS-AIS, TU-AIS, AU-LOP, TU-LOP	LP-FEBE	LP-FERF

Fig. 3-56 Anomalies and defects, STM-1 C-3

STM-1 C-12 frame system

Forwards		Backwards	
Anomaly	Defect	Anomaly	Defect
BIP-2	LOS, LOF, MS-AIS, TU-AIS, AU-LOP, TU-LOP, LOM	LP-FEBE	LP-FERF

Fig. 3-57 Anomalies and defects, STM-1 C-12

Calculation of error events

The following error events are counted and calculated only during the available time of the system, i.e. neither the error count or the error rates are incremented during the unavailable time.

1. **EB (Errored Block)**

   Block with ≥ 1 bit error

   Anomalies:
   Block with ≥ 1 anomaly
   If several anomalies occur simultaneously, the largest value in each case is taken into account.

2. **ES (Errored Seconds)**

   Seconds with ≥ 1 EB

3. **ESR (Errored Seconds Ratio)**

   Number of ES per available time

4. **SES (Severely Errored Seconds)**

   Seconds with ≥ m EBs
   m = 30 % of the total number of blocks (except for 2 Mbit/s CRC)

Frame system	Evaluated event	n [blocks / sec.]	SES threshold m [no. of EB]
STM-1 C-4	B3 HP-FEBE	8000 8000	2400 2400
STM-1 C-3	LP-B3 LP-FEBE	8000 8000	2400 2400
STM-1 C-12	BIP-2 LP-FEBE	2000 2000	600 600
140 Mbit/s	FASW	47563	14268
34 Mbit/s	FASW	22375	6712
8 Mbit/s	FASW	9962	2988
2 Mbit/s	FASW	4000	1200
2 Mbit/s CRC	CRCW	1000	805

Fig. 3-58 Relationship between anomalies and SES limits

5. **BBE (Background Block Errors)**

   EBs which are not counted as SES (< 30 % EBs of the total number of blocks)

6. **SESR (Severely Errored Second Ratio)**

   Number of SES per available time

7. **BBER (Background Block Error Ratio)**

   Number of BBEs per available blocks (excluding SES blocks)

8. **US (Unavailable Seconds = unavailable time)**

   Starts with 10 consecutive SES (which count towards the unavailable time).
   Ends with 10 consecutive non-SES (which count towards the available time).

As well as the above named error results, the error free seconds (EFS) are also given on the results page.

9. ACCEPTED / UNCERTAIN / REJECTED assessment

G.826 defines only one limit value for ES, SES and BBE, allowing only an assessment as ACCEPTED or REJECTED to be made for the path (in "Default" or "User defined" modes).

Path assessment as ACCEPTED / UNCERTAIN / REJECTED (similar to ITU-T M.2100) is achieved by comparing the number of ES, SES and BBE with the limit values specified by the user (in "User defined S1_S2" mode).
Limit values for ES, SES and BBE can be entered for two thresholds, S1 and S2. Threshold S1 must be ≤ S2.

ACCEPTED:	Number of ES, SES and BBE is below S1.
REJECTED:	At least one value (ES, SES and/or BBE) is above S2.
UNCERTAIN:	Number of ES, SES and BBE is between S1 and S2.

Measurement time

G.826 recommends a measurement time of one month.

The default setting when G.826 evaluation is activated is one hour (minimum recommended measurement time).

3.3.7 "Result Format" menu

The "Result Format" menu determines which information is to be displayed in the right-hand and left-hand halves of the main menu display.

To open the "Result Format" menu, start from the main menu page. If a menu other than the main menu is displayed, press the MAIN MENU key [15].

Now press key [5]. The "Result Format" menu is displayed in the right-hand half of the display instead of the RX and TX windows.

Fig. 3-59 Example of "Result Format" menu display for "Unframed Error Test" application, 140 Mbit/s

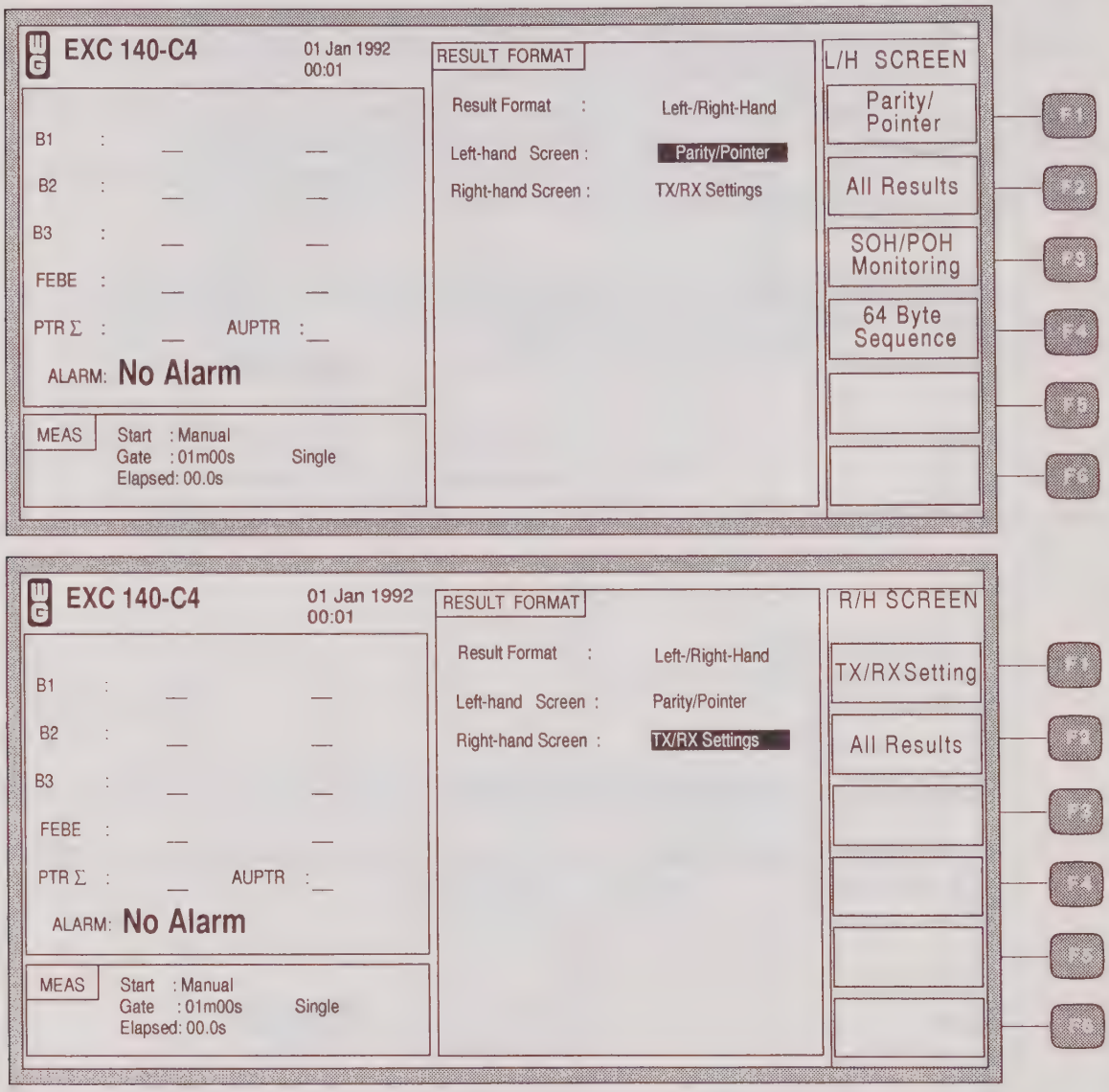


Fig. 3-60 Example of "Result Format" menu display for "SDH EXCHANGE 140-C4" application

The "Result Format" menu gives access to the following functions:

- Select the results to be displayed in the left-hand screen window: Counters 1 - 3, G.821 results; For STM-1: Parity/pointer results, all results, SOH/POH display, 64 byte sequence, TU-12 pointers (extra for STM-1 C-12 only).
  G.821 results can be selected if this analysis is selected in the "Measurement" menu
  G.826 results can be selected if this analysis is selected in the "Measurement" menu
- Select the parameters to be represented in the right-hand screen window (TX/RX Setting window, overall results, stored alarms and G.821/G.826 results if selected in the "Measurement" menu).

As the default settings for the counter assignments vary according to application and sometimes additional information is shown in the left-hand window, the "Measurement" menus for each application are reproduced on the following pages.

"SDH DEMUX", "PDH EXCHANGE", "PDH MUX", PDH DEMUX", "FRAMED PATTERN" and "Unframed Error Test" applications

The default setting shows the results for counters 1 to 3 in the left-hand window and the TX and RX settings in the right-hand window of the main menu display.

Counters 1 to 3 are assigned to BIT, CODE and BLOCK in the default settings for "Unframed Error Test" and "PDH DEMUX Test" (see figure 3-59).

In addition to the three counters, the following bits in the FAS / NFAS are displayed below counter 3, depending on the selected bit rate (see figures 3-61 to 3-63):

– For 2 Mbit/s: A-bit = 3rd bit, S_a bits = bits 4 - 8 of the NFAS

– For 140 Mbit/s: DNYY bits = bits 13 -16 of the FAS

– For 34/8 Mbit/s: DN bits = bits 11 and 12 of the FAS

These bits can be altered in the "TX/RX Frame" menu (MAIN MENU, F3).

The counter assignments can be changed from the "Measurement" menu.

"SDH EXCHANGE" and "SDH MUX Test" applications

The default setting for the "SDH EXCHANGE" and "SDH MUX" applications shows the fixed counters for B1, B2 and B3 parity errors, FEBE (C-4), LP-BIP (C-12), LP-B3 (C-3) and for pointer sum and AU pointer in the result format display (see figure 3-60).

The assignments can be changed from the "Measurement" menu.

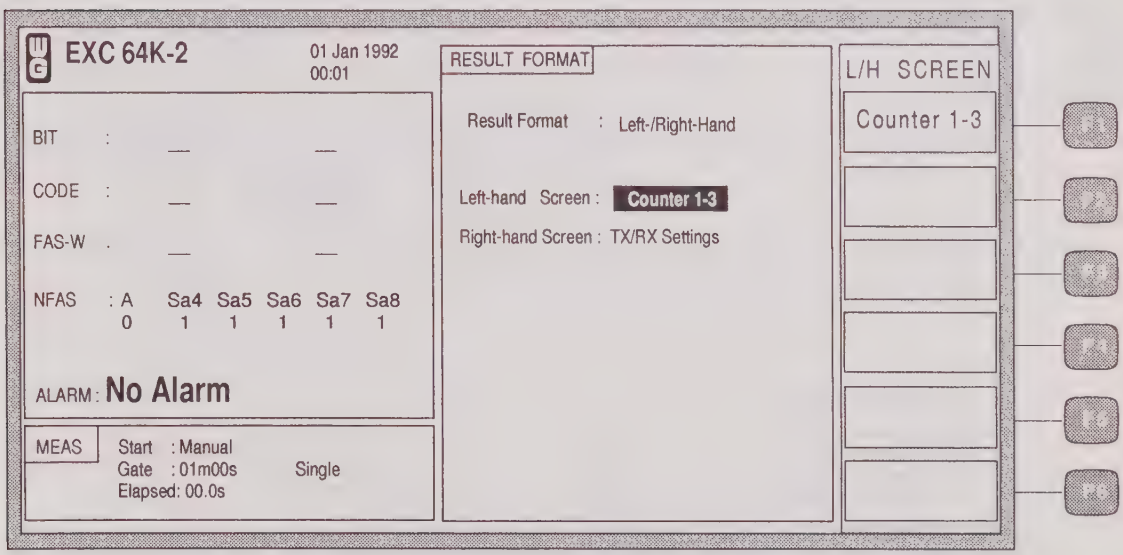


Fig. 3-61 Example of "Result Format" menu display for "PDH EXCHANGE 64K-2" application

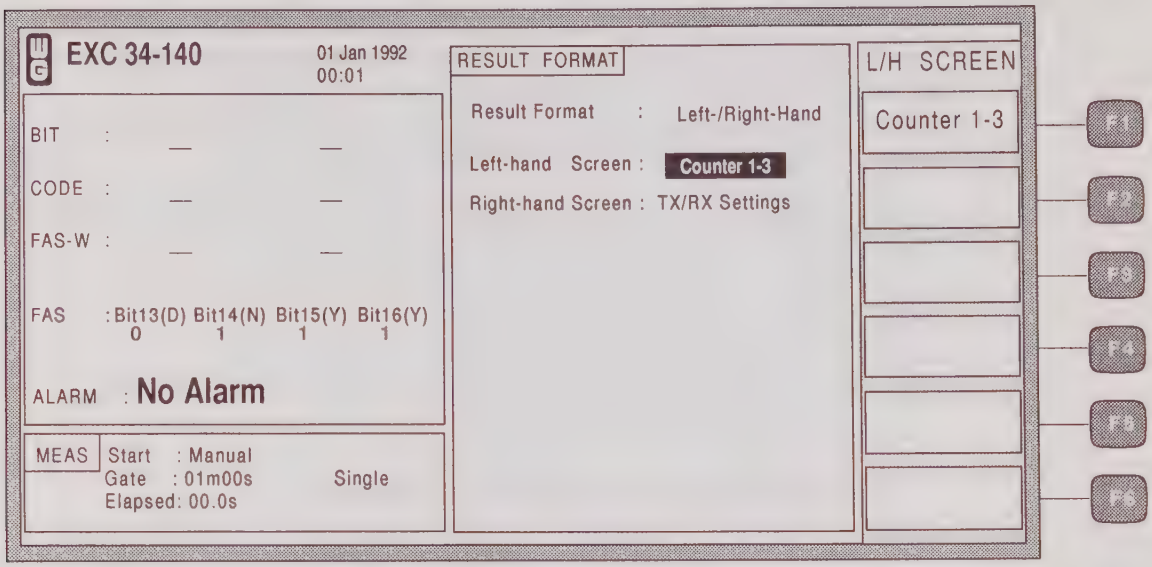


Fig. 3-62 Example of "Result Format" menu display for "PDH EXCHANGE 34-140"" application

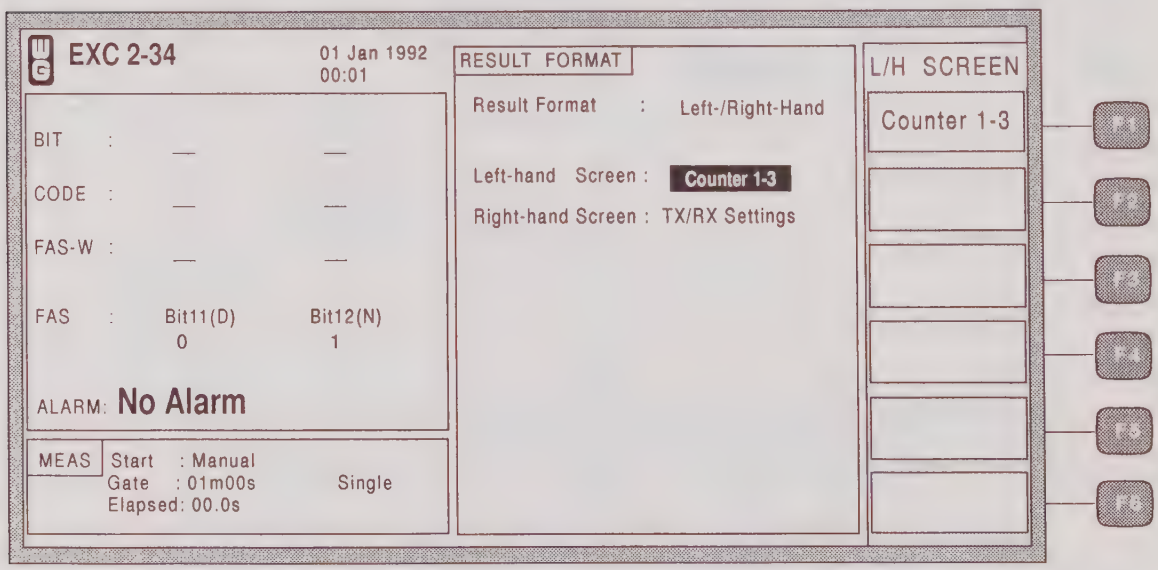


Fig. 3-63 Example of "Result Format" menu display for "PDH EXCHANGE 2-34" application

3.3.7.1 Left-hand "Result Format" window

Various results are shown in the left- and right-hand windows depending on the selections made in the "Result Format" menu. The following figures indicate the possible displays

"G.821" (F2) selected (in applications with RX = STM–1: F5)

The selection "G.821" only appears if "G.821" was selected as the "Analysis" parameter in the "Measurement" menu (see section 3.3.6.2).

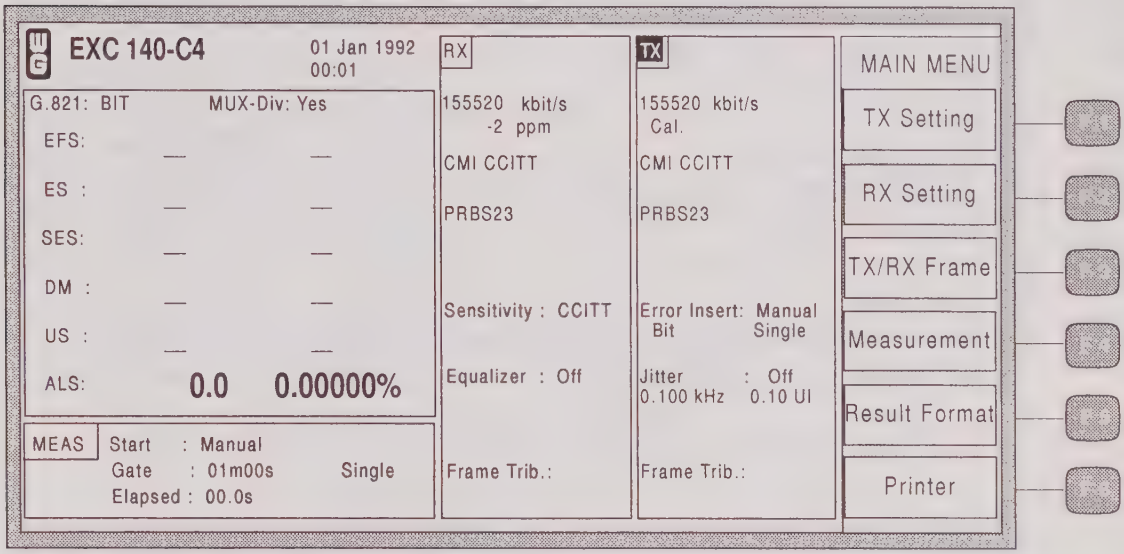


Fig. 3-64 Display after selecting "Left-hand window: G.821" for "SDH EXCHANGE 140-C4"

When "G.821" is selected for the left-hand window of the display, six counters for the G.821 evaluation are listed instead of the counters and current alarm display of the default setting:

EFS Error free seconds

ES Errored seconds

SES Severely errored seconds

DM Degraded minutes

US Unavailable seconds

ALS Alarm seconds: The sum of all seconds with an alarm detected during the measurement time, resolved into 0.1 second intervals and constantly updated. The result is stored in the result memory and output in the G.821 printout together with a timestamp.

The results are shown as absolute error counts and as ratios referred to the relevant measurement interval.

"G.826" selected (F2 if RX = PDH signal, F5 if RX = SDH signal)

"G.826" is available for selection if "G.826" was selected for the "Analysis" parameter in the "Measurement" menu (see section 3.3.6.3).

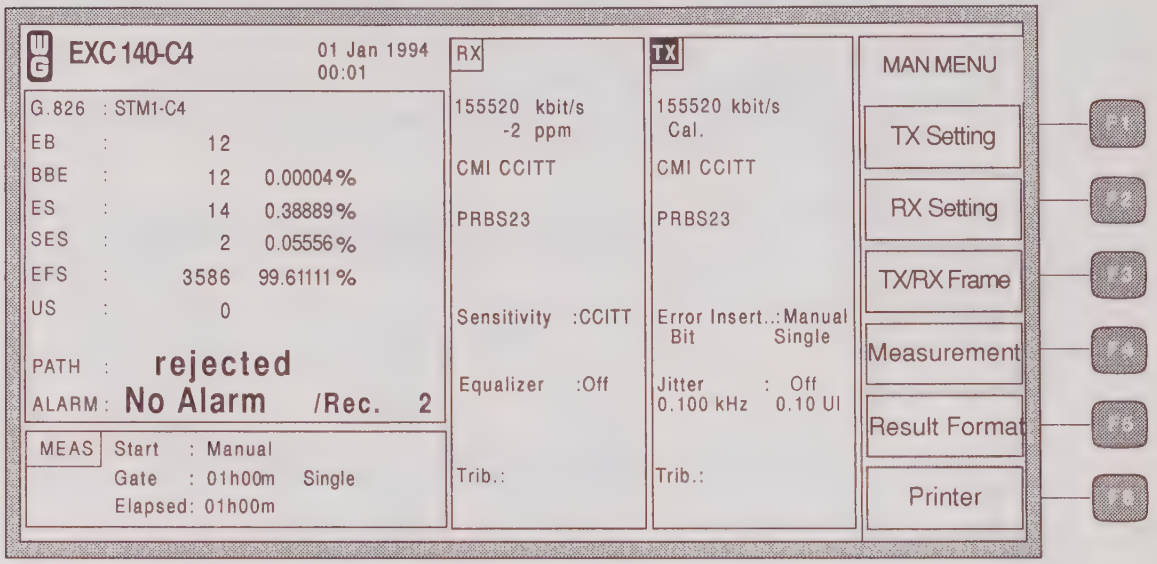


Fig. 3-65 Display after selecting "Left-hand window: G.826", with measurement running

"All Results" (F2) selected (in applications with RX = STM-1 only)

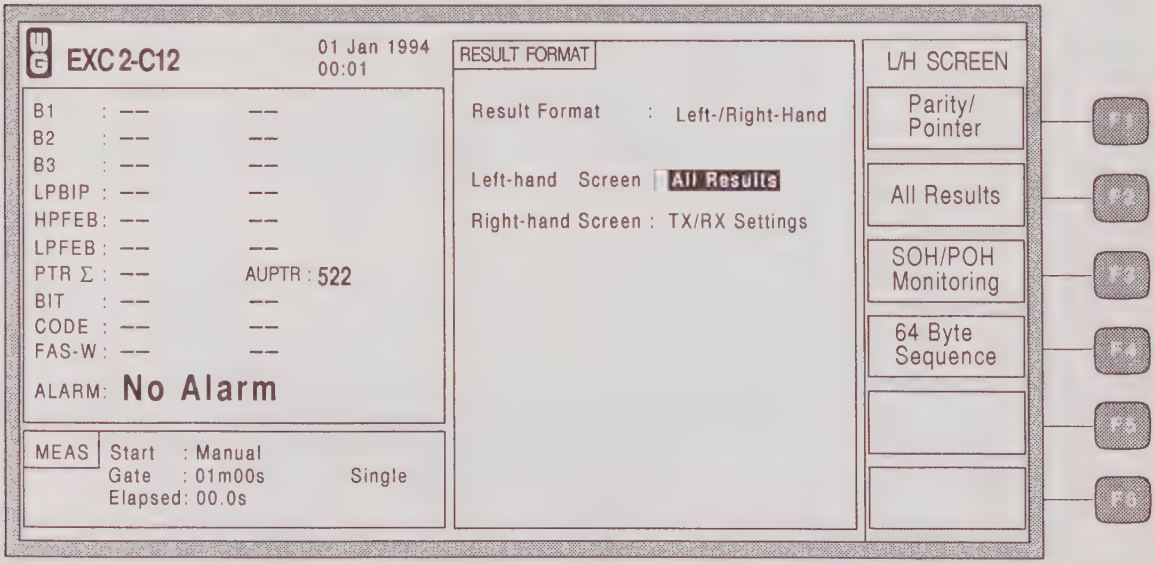


Fig. 3-66 Display after selecting "Left-hand window: All Results" for "SDH EXCHANGE 2-C12"

"SOH/POH Monitoring" (F3) selected (in applications with RX = STM–1 only)

This setting for the left-hand display window allows the SOH and POH of the received signal to be observed and analyzed.

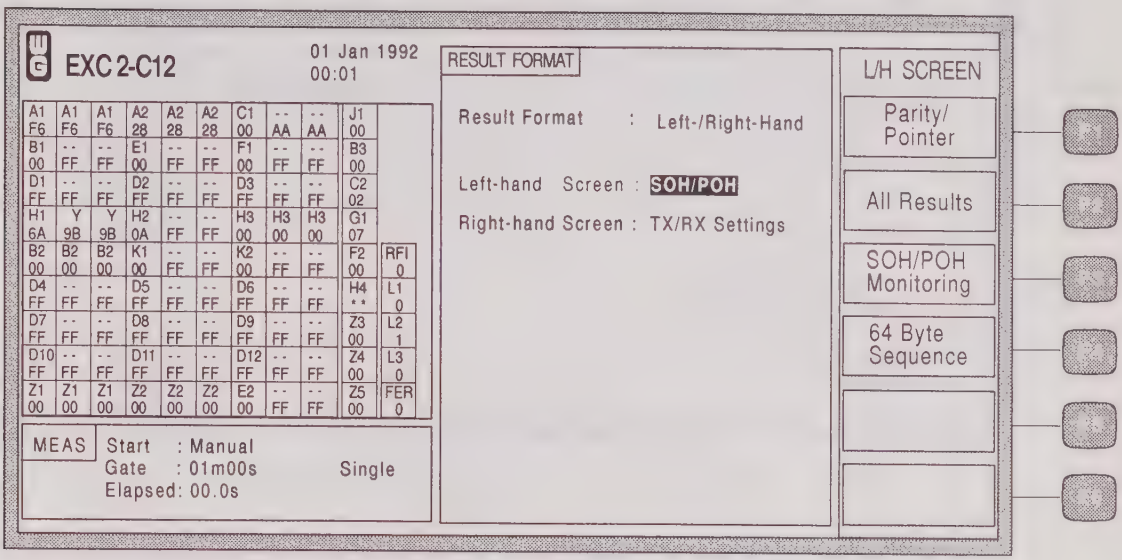


Fig. 3-67 Dislay after selecting "Left-hand window: SOH/POH" for "SDH EXCHANGE 2-C12"

If the signal is correctly transmitted, only the parity sums B1, B2 and B3 will change continually and the hexadecimal value of the H4 byte will change over a sequence of four frames from FC to FD to FE to FF.

The hexadecimal values which indicate alarms in certain bytes are indicated in the "Alarms" table in section 8.4.1.3.

"64 Byte Sequence" (F4) selected (in applications with RX = STM-1 only)

Any SOH or VC-4 POH byte across 64 consecutive frames can be displayed instead of the entire SOH or POH of the received signal.

Display of the byte selected in the "TX/RX Frame" menu is in hexadecimal and ASCII characters.

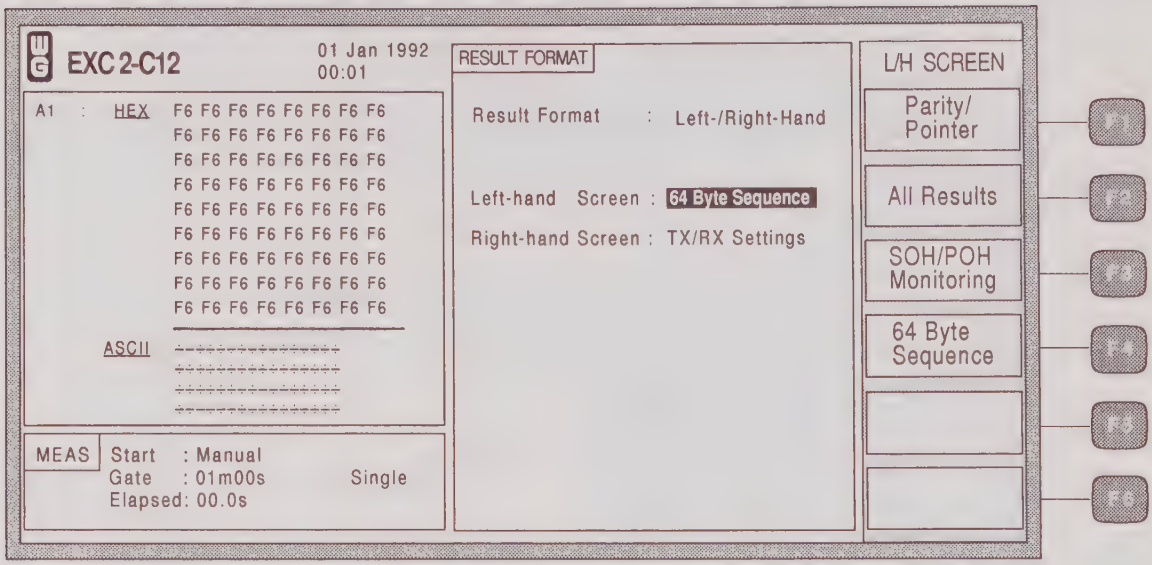


Fig. 3-68 Display after selecting "Left-hand window: 64 Byte Sequence" for " SDH EXCHANGE 2-C12"

The example above shows the display of the A1 byte (line 1 column 1 of the SOH) with its hexadecimal and ASCII values over a sequence of 64 frames.

"TU–12 pointer" (F5) selected (in applications with RX = STM–1 C–12 only)

If the "TU–12 Eval." parameter is set to "On" in the "Measurement" menu, function key F5 is assigned the additional function "TU–12 Pointer Monitoring" in the "Result Format" menu.

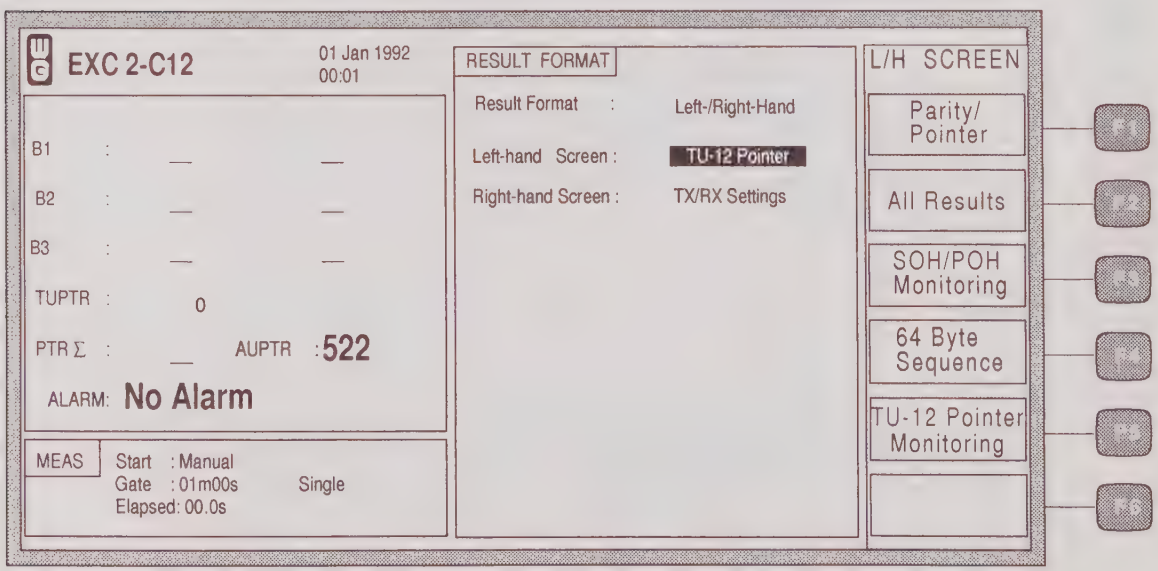


Fig. 3-69 STM–1 C–12 application, "Result Format", "Left-hand Window" when "TU–12 Eval. = On" selected in "Measurement" menu

3.3.7.2 Right-hand "Result Format" window

"All Results"(F2) selected

If all results, i.e. counters 1 to 3, the fixed counters for STM-1 (B1, B2, B3, PTR-, PTR+, PTR Σ, HP-FEBE, LP-FEBE, LP-BIP, LP-B3) and the G.821 evaluation results are to be displayed simultaneously, select F2 "All Results" for the right-hand window. To display the G.821/G.826 results for STM–1 applications, F2 "G.821" (or "G.826") should also be selected in the left-hand window. Depending on the bit rate of the application, the display will have the following structure:

RX bit rate of selected application	Results in right-hand window	Results in left-hand window
2, 8, 34, 140 Mbit/s	G.821 (or G.826) evaluation, RX amplitude	Default setting: Counter 1-3, and for: Framed 2 Mbit/s: NFAS, bits 3-8 Framed 8, 34 Mbit/s: FAS, bits 11-12 Framed 140 Mbit/s: FAS, bits 13-16
STM-1 C-4	B1, B2, B3 error counters, FEBE Pointer counters(+, -, sum) AU pointer Counter 1-3 RX amplitude	G.821 (or G.826) results
STM-1 C-12, C-3	B1, B2, B3 error counters, LP-BIP (C-12), LP-B3 (C-3) HP-FEBE LP-FEBE Pointer counters(+, -, sum) AU pointer Counter 1-3 RX amplitude	G.821 (or G.826) results

Fig. 3-70 Display of results after selecting "All Results" in the left-hand/right-hand window

The following figures show the menu displays for the window assignments given above.

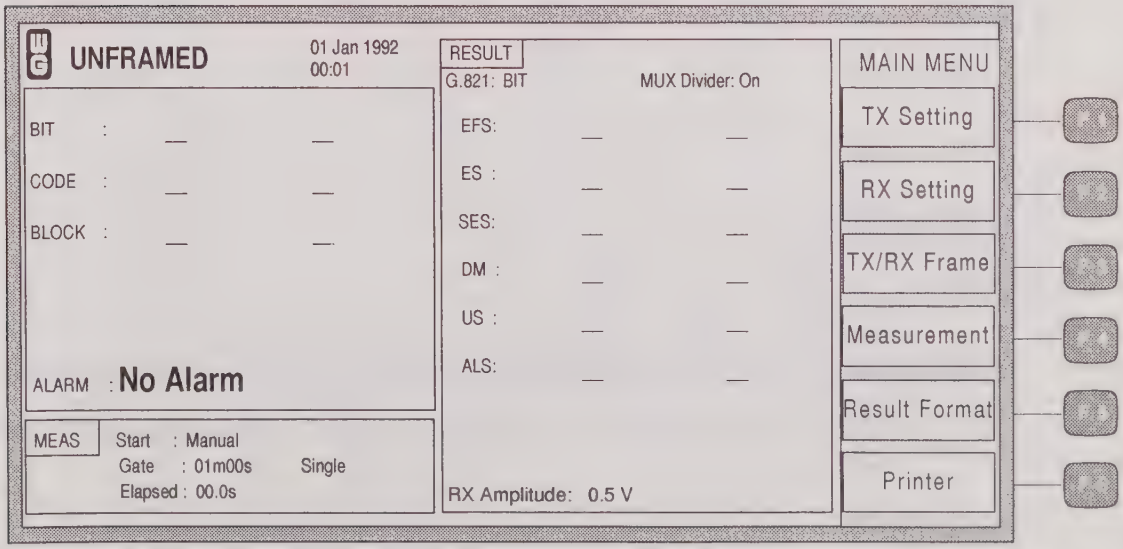


Fig. 3-71 Display after selecting "Right-hand window: All Results" for "Unframed Error Test 140 Mbit/s"

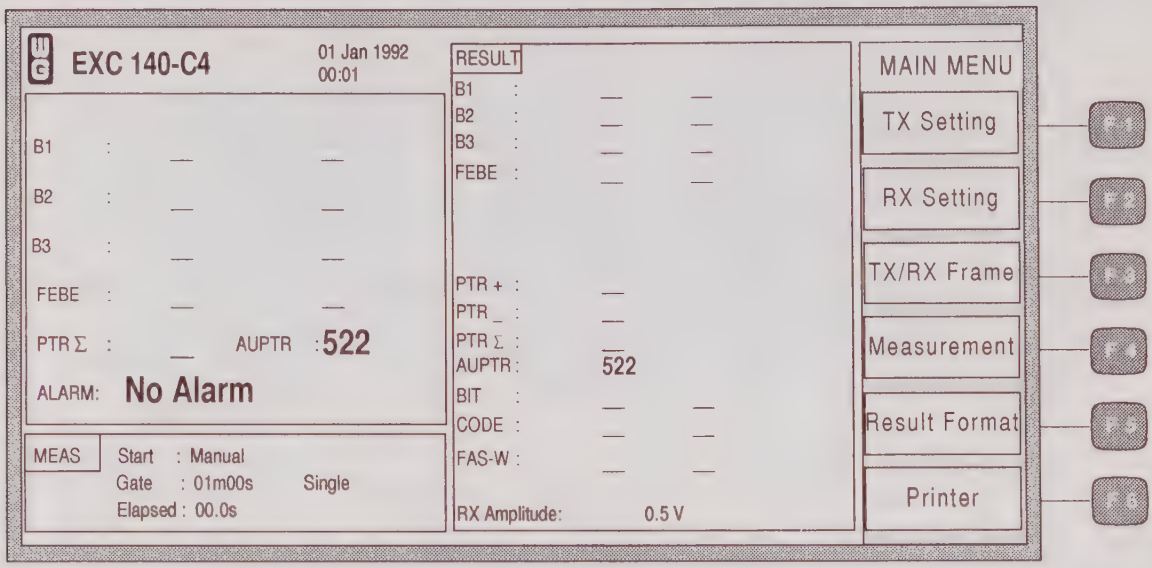


Fig. 3-72 Display after selecting "Right-hand window: All Results" for "SDH EXCHANGE 140-C4"

"G.821" (F2) selected (for applications with RX = 155 Mbit/s: F3)

"G.821" is available for selection only if "G.821" was selected for the "Analysis " parameter in the "Measurement" menu.

To allow the results of counters 1 - 3 and the G.821 results to be displayed simultaneously, select "G.821" for the right-hand window and "Counter 1-3" for the left-hand window from the "Result Format" menu for bit rates from 2 - 140 Mbit/s. The display then has the following layout:

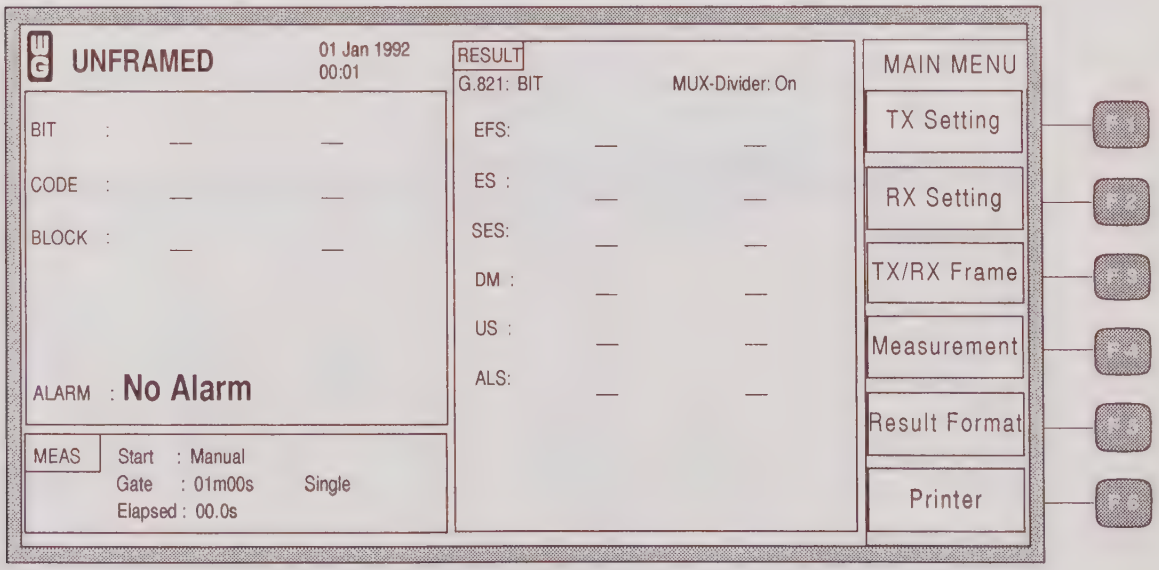


Fig. 3-73 Display after selecting "Right-hand window: G.821" for "Unframed Error Test 140 Mbit/s"

"G.826" selected (F3, for framed signals only)

"G.826" is available for selection only if "G.826" was selected for the "Analysis" parameter in the "Measurement" menu.

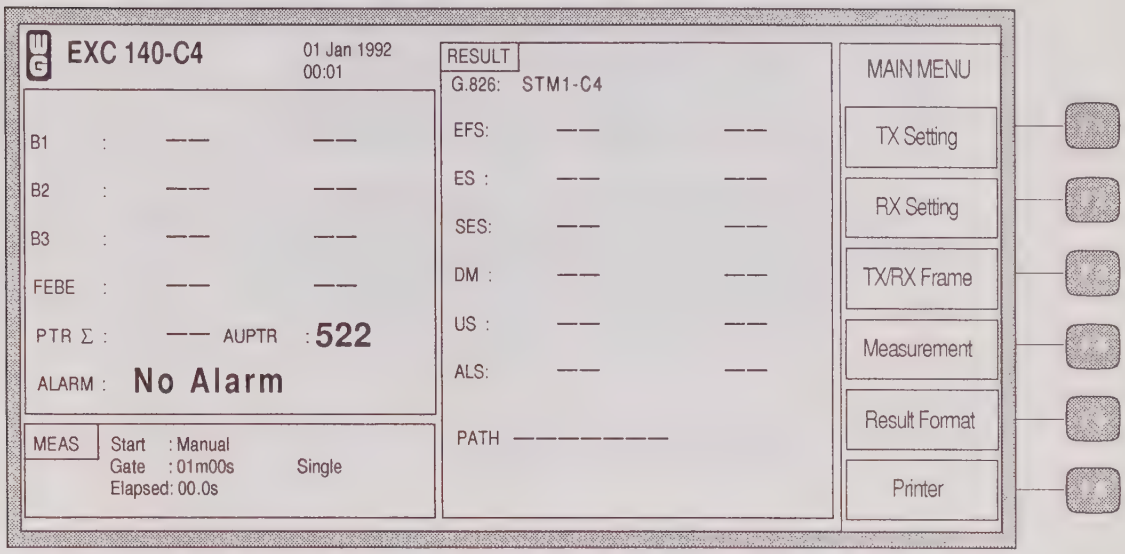


Fig. 3-74 Display after selecting "Right-hand window: G.826" for "SDH Exchange 140-C4""

3.3.7.3 "Histogram" (F1) result format display

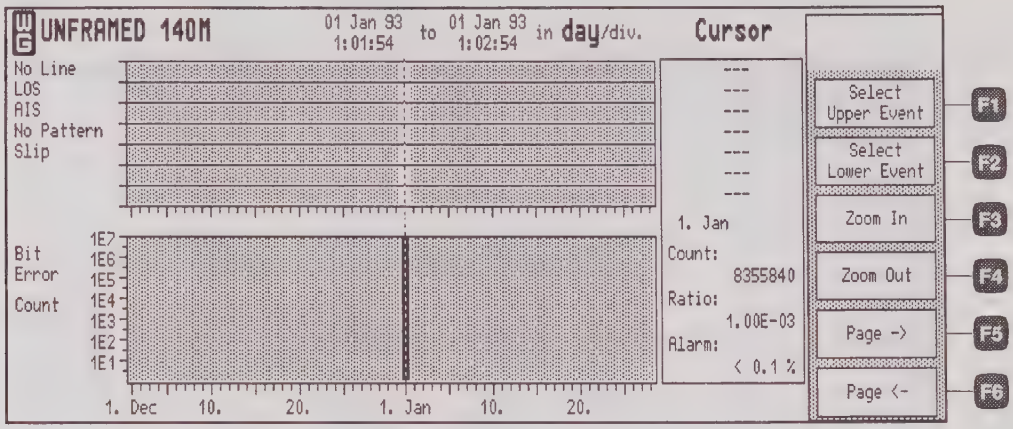


Fig. 3-75 Display after selecting "Result Format: Histogram" after an error measurement using the "UNFRAMED 140 Mbit/s" application

Note: You can only switch to the "Histogram" display when results are available.

Display layout

Selecting the "Histogram" display causes the entire screen area to be filled with a graphics display of the errors and alarms detected within the complete measurement period for one measurement.

- The title bar shows the application, date and measurement time for the measurement and the selected time units.
- The measurement time is indicated by a bright background within the display. Times before and after the measurement are indicated by a dark grey raster in the display.
- The results are shown as black bars in the display.
- Both of the histograms (upper and lower halves of display) have the same time axis.
- The function keys are used to select which error event or alarms are to be shown in the upper and lower halves of the display.
- The cursor (dotted vertical line above both displays) can be moved along the time axis using the cursor keys [15].
- The data for the current cursor position are shown in the "Cursor" field on the right-hand side of the display. This includes the error count and error rate for the selected error event, the duration of the alarms and the date andf time corresponding to the cursor position.

"Select Upper Event" (F1) or "Select Lower Event" (F2)

You can select between the following events for display in the upper and lower halves of the results display:

- Alarms 1
  For UNFRAMED applications:
  Power Off, LOS, Micro-interrupt, Pattern AIS, No Pattern, Pattern Slip

  For SDH applications:
  Power Off, LOS, Micro-interrupt, LOF for the appropriate frame systems, AU-AIS, AU-LOP, MS-AIS (C12)

  For PDH applications:
  Power Off, LOS, Micro-interrupt, AIS for the appropriate frame systems, LOF for the appropriate frame system, Pattern AIS, No Pattern

- Alarms 2 (additionally for framed signals)
  For SDH applications:
  LOM (C12), TU-LOP, TU-AIS, AIS for the appropriate frame systems, LOF for the appropriate frame systems, Pattern AIS, No Pattern

  For PDH applications:
  Pattern Slip

- Alarms 3 (additionally for STM-1 signals)
  Pattern Slip

- together with various error types (selection depends on application)

"Zoom In" (F3) or "Zoom Out" (F4)

These functions are used to alter the resolution of the time axis. Possible resolution values are:

- 1 Day per division
- 1 Hour per division
- 1 Minute per division
- 1 Second per division

When "Zoom In" (F3) is pressed, the current time units are reduced by one step, e.g. from Day/Div. to Hour/Div. Each time F3 is pressed, the unit reduces by a further step until maximum resolution (Second/Div.) is reached.

Key F4 "Zoom Out" has the opposite effect. Each time F4 is pressed, the unit increases by one step, e.g. from Second/Div. to Minute/Div.

"Page ->" (F5) or "Page <-" (F6)

If high resolution is selected for the display (e.g. Minute/Div. or Second/Div.) and the measurement time was longer than thatr which can be displayed entirely on the screen, function keys F5 and F6 allow you to page backwards and forwards through the results.

Each time you "turn" a page, the cursor moves to the middle of the time axis.

You can also move back or forward a page by moving the cursor outside the left-hand or right-hand margin of the display by means of the cursor keys [15].

3.3.7.4 "Alarm History" (F2) result format display

The alarms occurring during a measurement can be displayed as a table instead of a histogram. For this, the black marker bar must be placed on "Result Format" in the "Result Format" menu. Then press F2 "Alarm History".

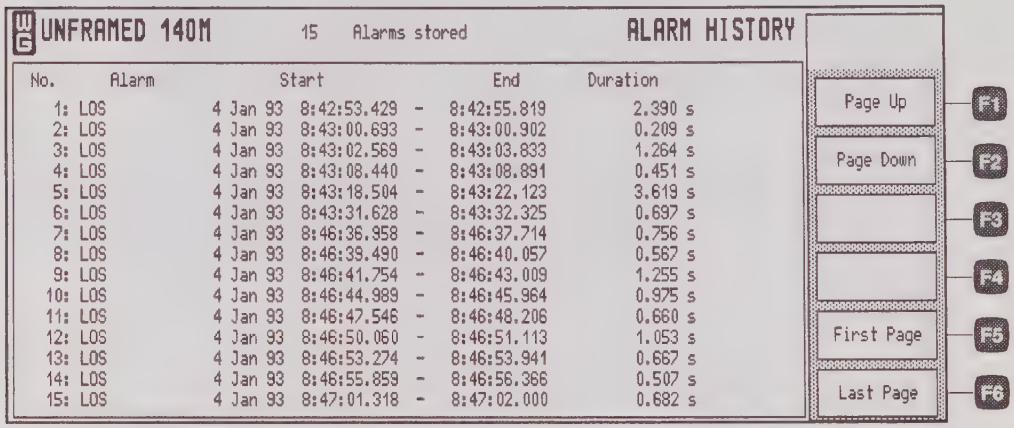


Fig. 3-76 Display after selecting "Result Format: Alarm History" after an error measurement using the "UNFRAMED 140 Mbit/s" application

Display layout

- The title bar shows the name of the application and the number of alarms registered and stored during the measurement.
- The table columns are: Alarm No. (chronological order), Alarm Type, Start of Alarm, End of Alarm (both showing date and time), Alarm Duration
- 15 alarms fit on to one page of the display. If more than 15 alarms were stored, the alarm history will cover more than one page. These pages can be displayed using the function keys F1, F2, F5 and F6.

Warning: The alarm memory is cleared each time a measurement is started.

You can see whether alarms have been detected and recorded during a measurement by observing the "Alarm:" line in the left-hand results window of the main menu. The number of alarms stored to date during the measurement is shown after the current signal status (e.g. "No Alarm"); see figure 3-77. The abbreviation "Rec." stands for "Recorded".

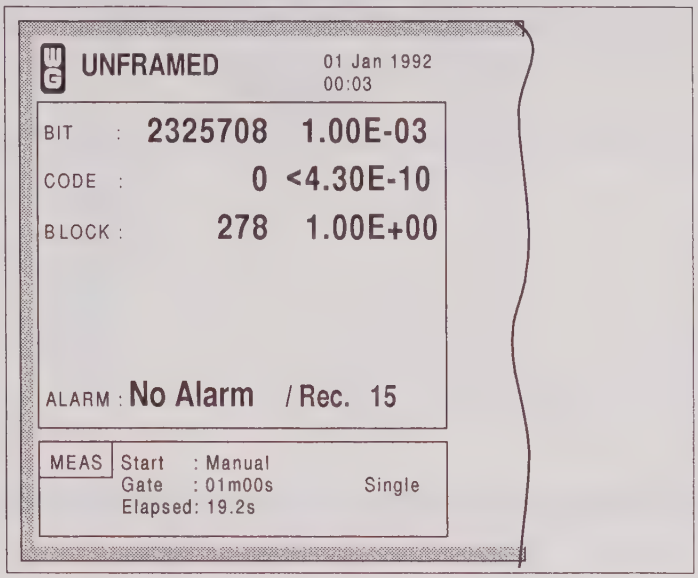


Fig. 3-77 Display of the number of alarms recorded to date during a measurement

3.3.8 "Printer" menu

To open the "Printer" menu, start from the main menu page. If a menu other than the main menu is displayed, press the MAIN MENU key [15].

Now press key [6]. The "Printer" menu is displayed in the right-hand half of the display instead of the RX and TX windows.

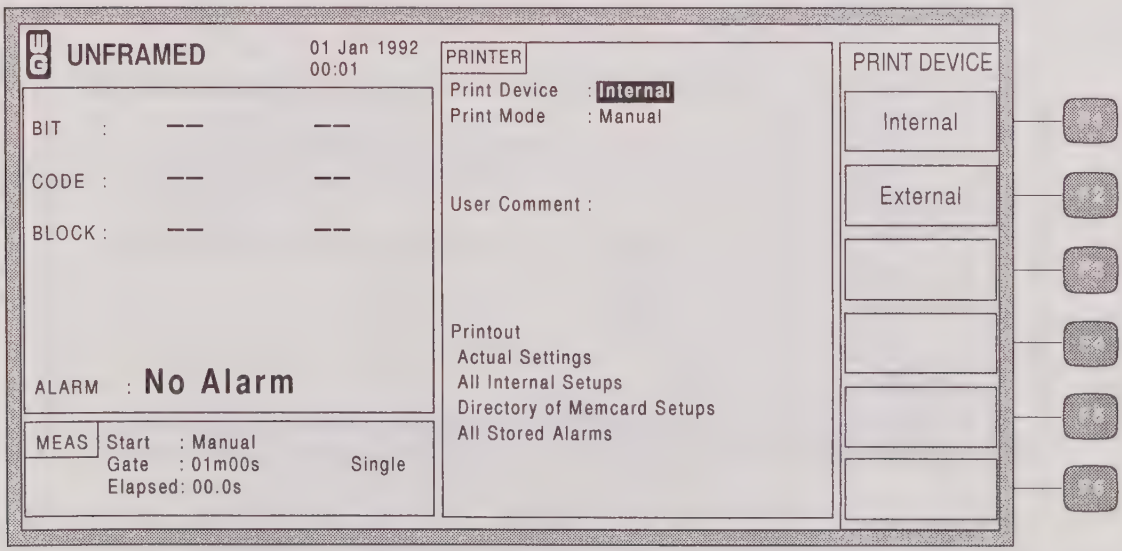


Fig. 3-78 Example of "Printer" menu display for "Unframed Error Test" application, 140 Mbit/s

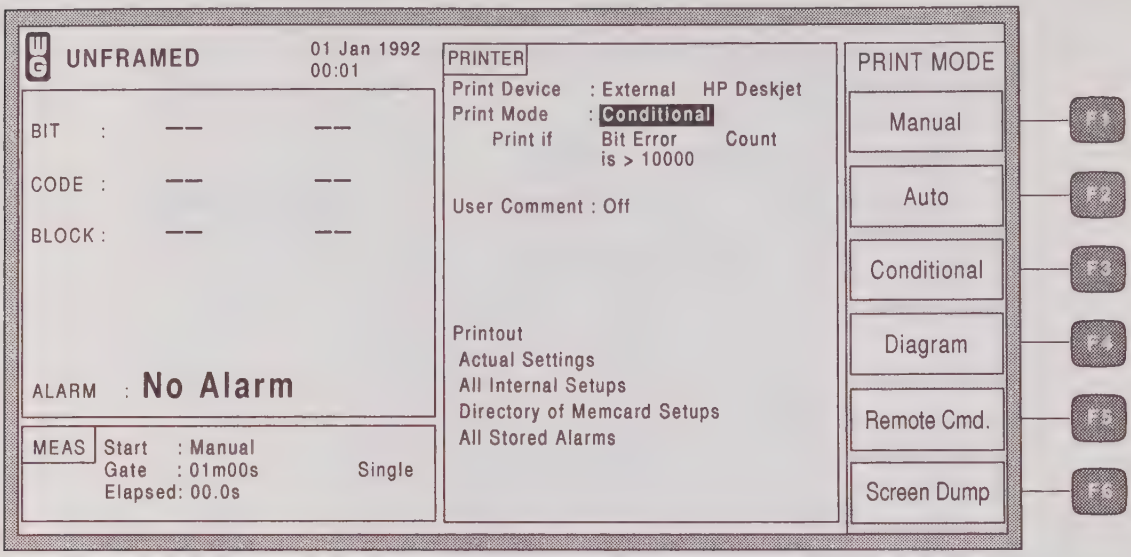


Fig. 3-79 Example of "Printer" menu display after selecting "Conditional" for "Print Mode"

The "Printer" menu gives access to the following functions:

- Printer selection
  - internal printer, or
  - external printer connected via the V.24 interface; The "V.24 interface" mode must be set to "Printer" in the "Test & Configuration" menu.
    When an external printer is connected, pressing the "Print" key causes a screen dump to the printer. It is not possible to print out just the results.
  - printer type (when external printer used): HP Deskjet/HP Laserjet /IBM Proprinter/Epson FX.
- Set print mode
  manual print trigger
  automatic print trigger
  entry of error threshold above which the results are to be printed out (Print Mode: Conditional, see figure 3-79)
  entry of the event to be output in diagram form (Print Mode: Diagram)
  print out of remote control command corresponding to each manually performed entry (Print Mode: Remote Cmd)
- Enter text (Header 1, Header 2) to be printed out as header for the printout.
- Print actual device settings
- Print all internal stored setups
- Print directory of memory card setups (Memcard)
- Print all stored alarms.

The possible selections available for these parameters are found in the "Printer" menu tree in section 3.1.4.

3.3.9 "Autoconfiguration" menu [19]

To open the "Autoconfiguration" menu, press key [19] AUTO CONF, regardless of the current menu display. The "Autoconfiguration" menu will be displayed over the full screen area.

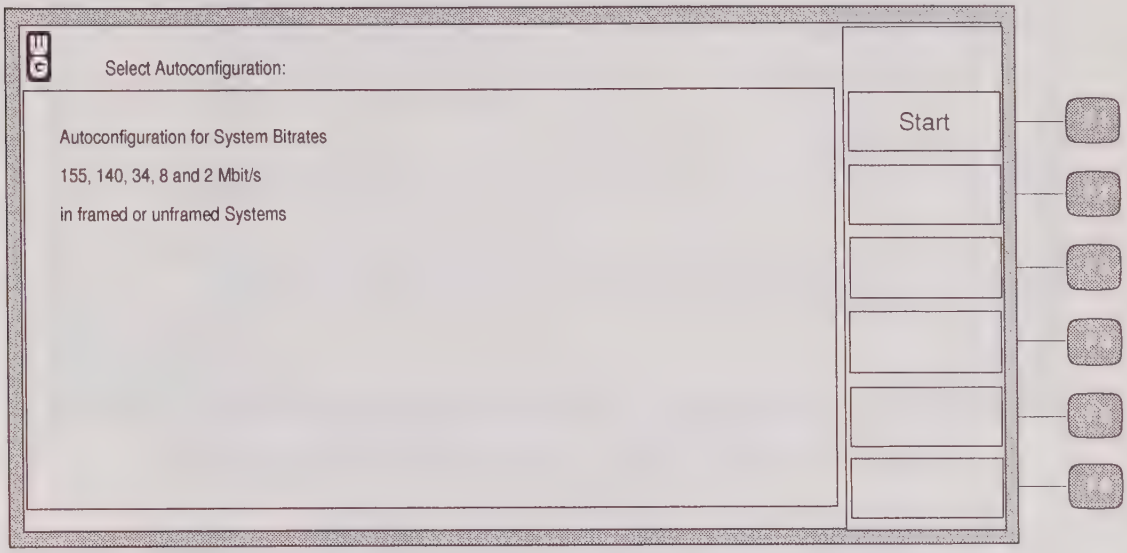


Fig. 3-80 "Autoconfiguration" menu display [19]

After pressing key [1] ("Start"), the following appears:

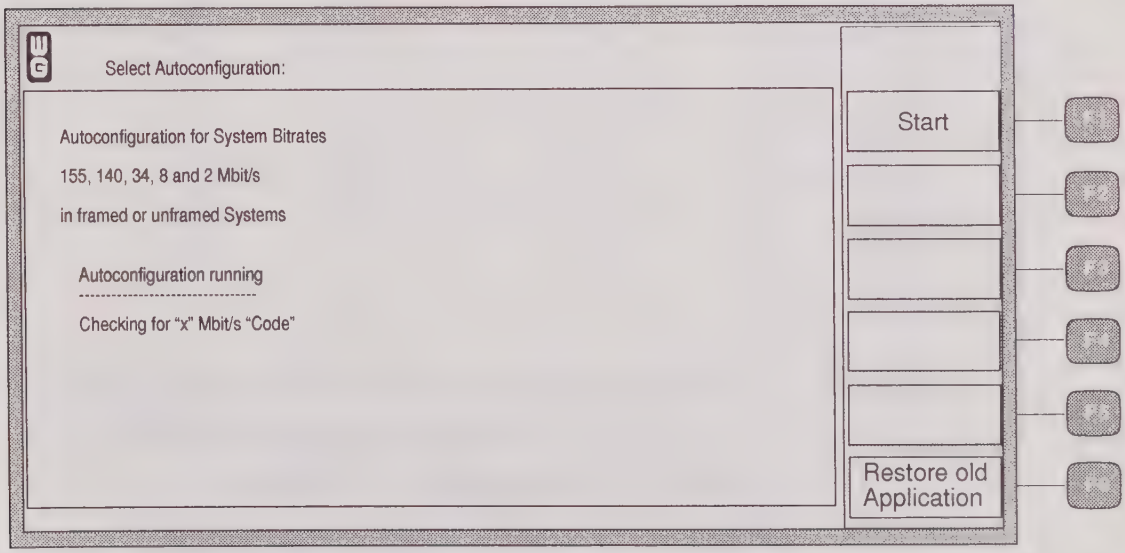


Fig. 3-81 "Autoconfiguration" display, autoconfiguration in progress

After pressing key [1] ("Start") in the "Autoconfiguration" menu, the RX signal is checked for system bit rate, line code, pattern and the signal level (CCITT or PMP). Once the signal has been identified, the receiver and generator are set automatically to the parameters for this signal.

After successful completion of autoconfiguration, the following is displayed:

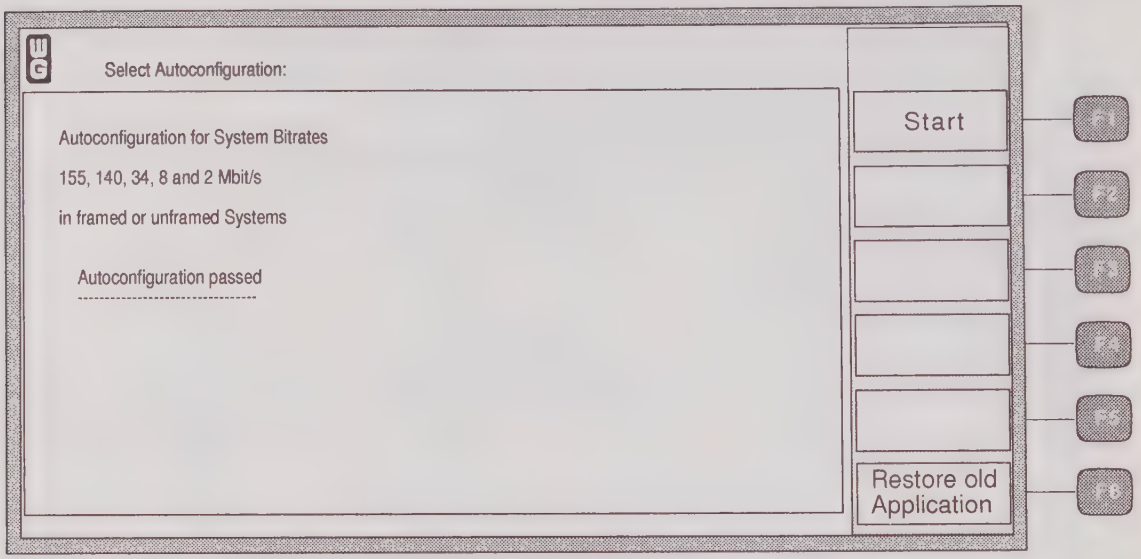


Fig. 3-82 "Autoconfiguration" display, autoconfiguration successfully completed

After about 2 seconds, the main menu display will appear.

If autoconfiguration was unsuccessful, the following is displayed:

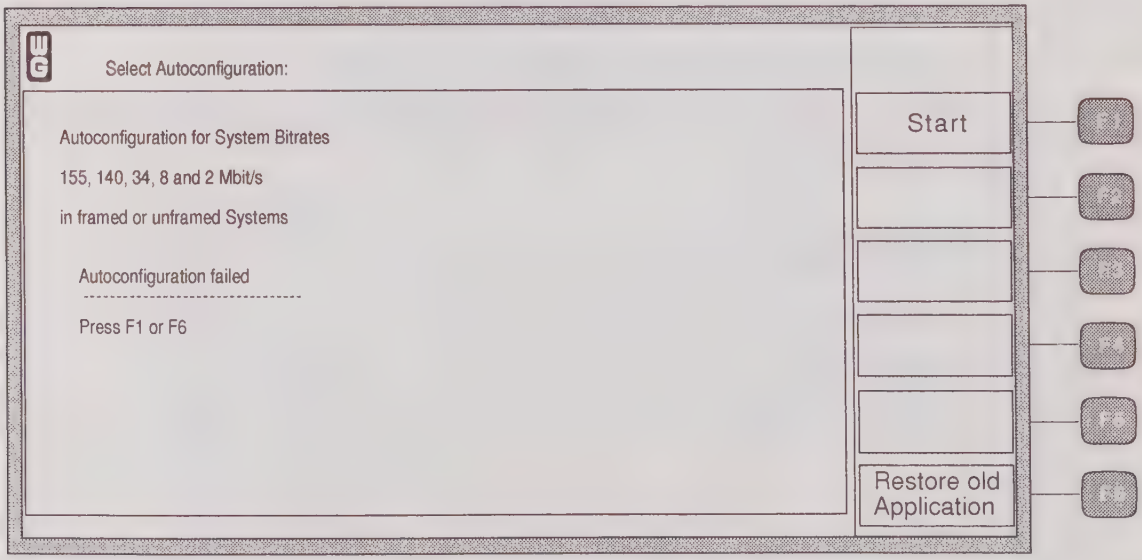


Fig. 3-83 "Autoconfiguration" display, autoconfiguration unsuccessful

Unsuccessful autoconfiguration

The SF-60 will not be able to perform autoconfiguration (figure 3-83) if:

1 The received signal does not conform to the ITU-T requirements for system bit rate / code / pattern:
155 520 kbit/s / CMI / PRBS 23
139 264 kbit/s / CMI / PRBS 23
34 368 kbit/s / HDB3 / PRBS 15
8 448 kbit/s / HDB3 / PRBS 15
2 048 kbit/s / HDB3 / PRBS 15

and/or

2 The received signal level does not conform to ITU-T or is below the PMP level (e.g. when no signal is present)

Note: If autoconfiguration is unsuccessful, try again. If the second attempt is also unsuccessful, press function key [6] "Restore old Application" to exit from the "Autoconfiguration" menu and return to the previous application menu.

3.3.10 "Memory" menu [20]

To open the "Memory" menu, press key [20] MEM, regardless of the current menu display. The "Memory" menu will be displayed over the full screen area.

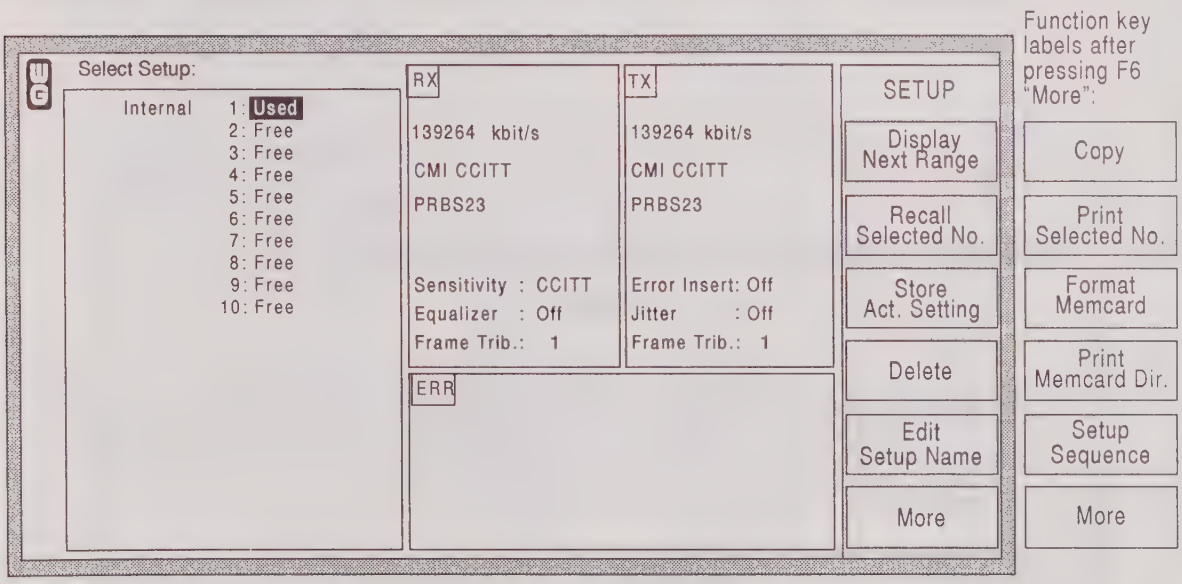


Fig. 3-84 "Auswahl Setup" menu display

This menu gives access to the following functions:

- Display next range (Internal: 1-10, Memory Card: 101-110, 201-210)
  Recall selected setup number
  Store actual device setting as setup
  Delete marked setup
  Edit setup name
  Copy setups
  Print marked setup
  Format memory card
  Print directory of memory card setups
  Start a measurement sequence composed from several setups

Notes on figure 3-84

If the setup memory is empty, the memory positions 1 to 10 (internal) shown on the left-hand side of the display are marked with "Free". The RX, TX and ERR (for error texts) windows are also empty.

The example shows a device setting stored at Setup No. 1 (indicated by "Used"). The more important parameters for the stored setup are shown in the TX and RX windows.

To view the complete data for the setup, press F2 **"Recall Selected No.**". The stored setup is then displayed with the same format as the result display selected using MAIN MENU, F5 "Result Format" before the setup was stored.

Function key [1] "Display Next Range" (memory card in slot)

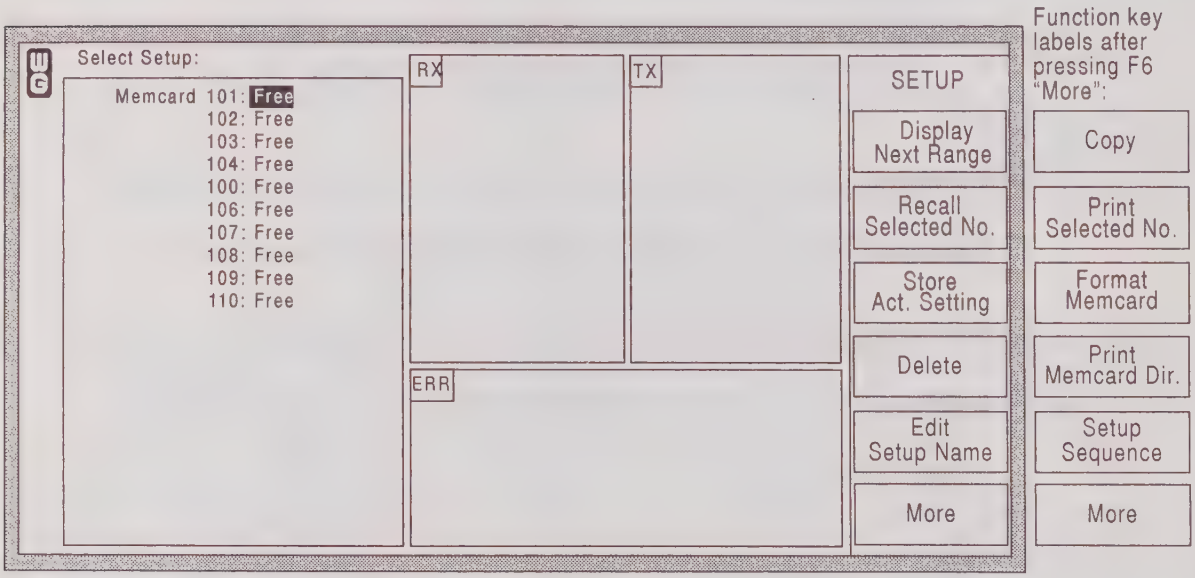


Fig. 3-85 "Display Next Range" menu display

Pressing [1] causes the next setup memory range to be displayed in the left-hand window. As only 10 spaces are available internally, the next range is the first 10 spaces on the memory card; these spaces can only be displayed if a memory card is put into the slot **before** key [1] is pressed. Otherwise, the following will appear in the ERR window at the bottom of the screen:

The S64k memory cards supplied with the SF-60 have a capacity of up to 20 setups. If [1] "Display Next Range" is pressed again, the remaining 10 spaces on the card (201 - 210) will be displayed.

Function key F4 "Delete":

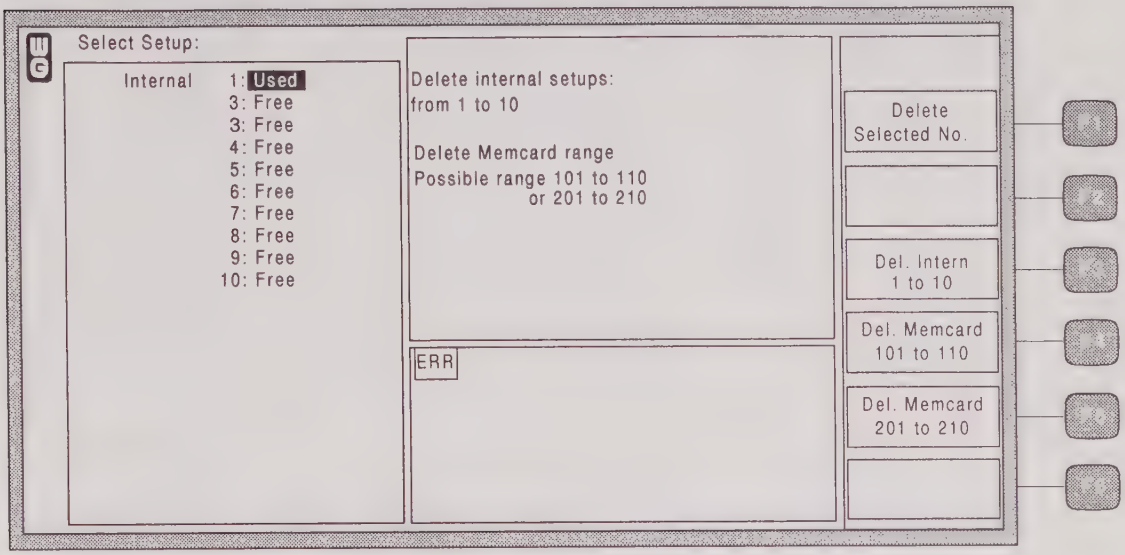


Fig. 3-86 "Delete" menu display

Function key F5 "Edit Setup Name"

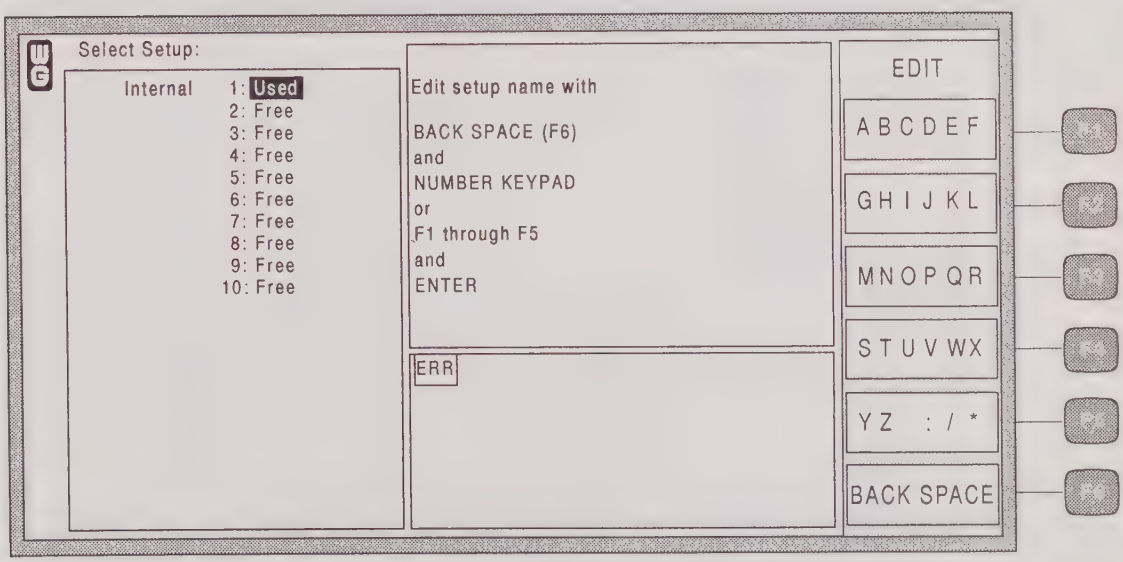


Fig. 3-87 "Edit Setup Name" menu display

Function keys F6, F1 "Copy"

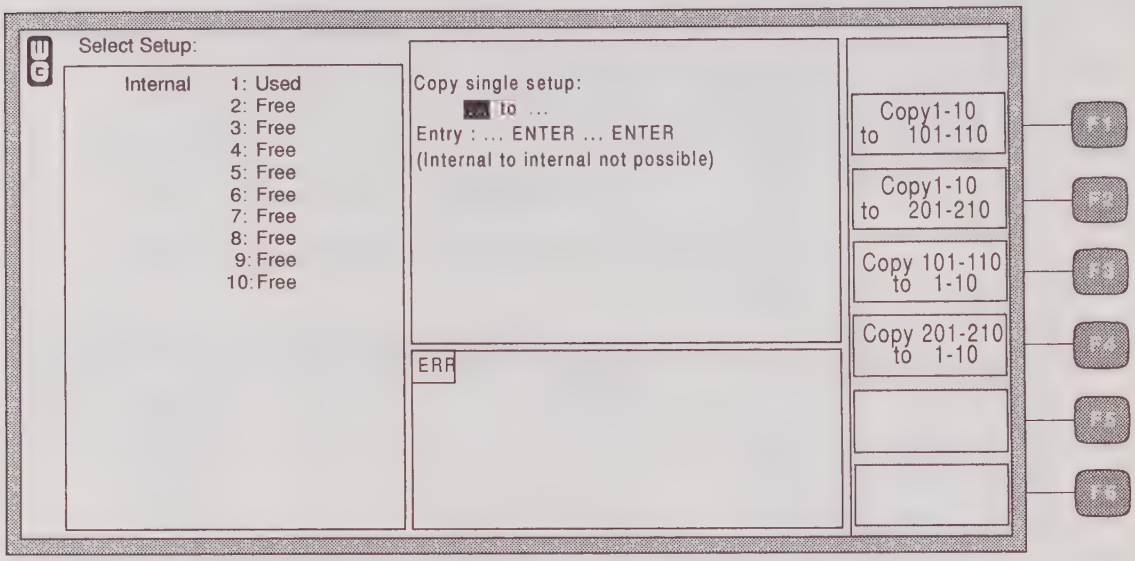


Fig. 3-88 "Copy" menu display

Function keys F6, F3" Format Memcard"

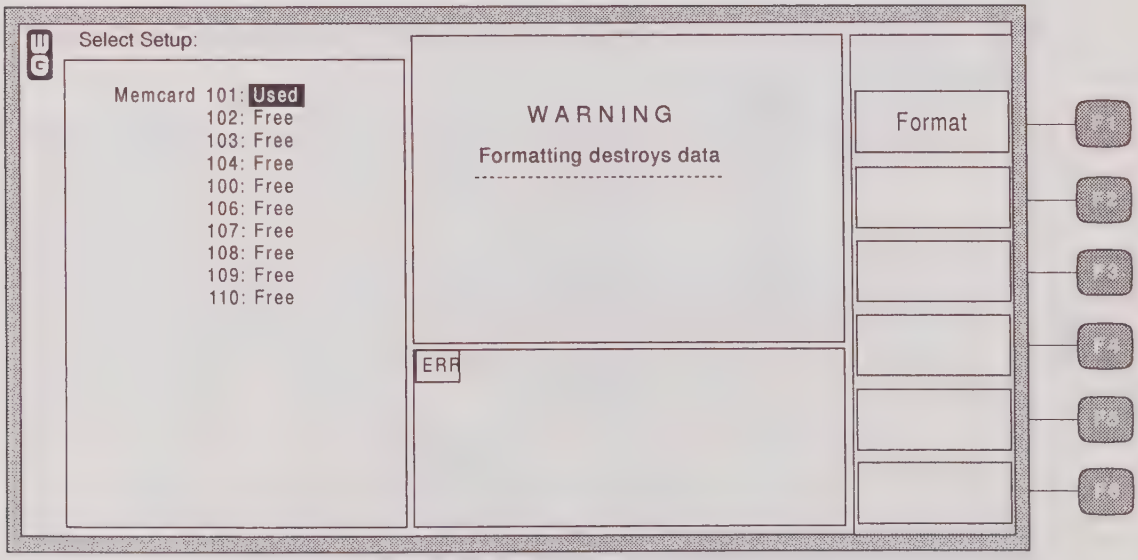


Fig. 3-89 "Format Memcard" menu display

Function keys F6, F5"Setup Sequence"

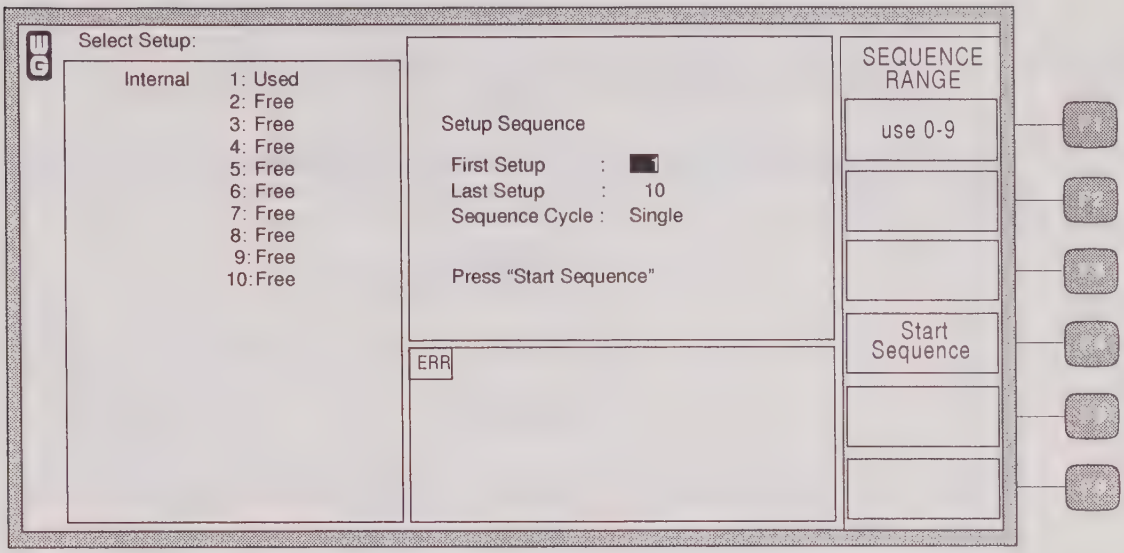


Fig. 3-90 "Setup Sequence" menu display

3.3.11 "Test & Configuration" menu [21]

The "Test & Configuration" menu is opened from the main menu. To return to the main menu, press [15] MAIN MENU.

To open the "Test & Configuration" menu, press key [21] "TEST/CONF". The "Test & Configuration" menu will then be displayed in the right-hand screen window.

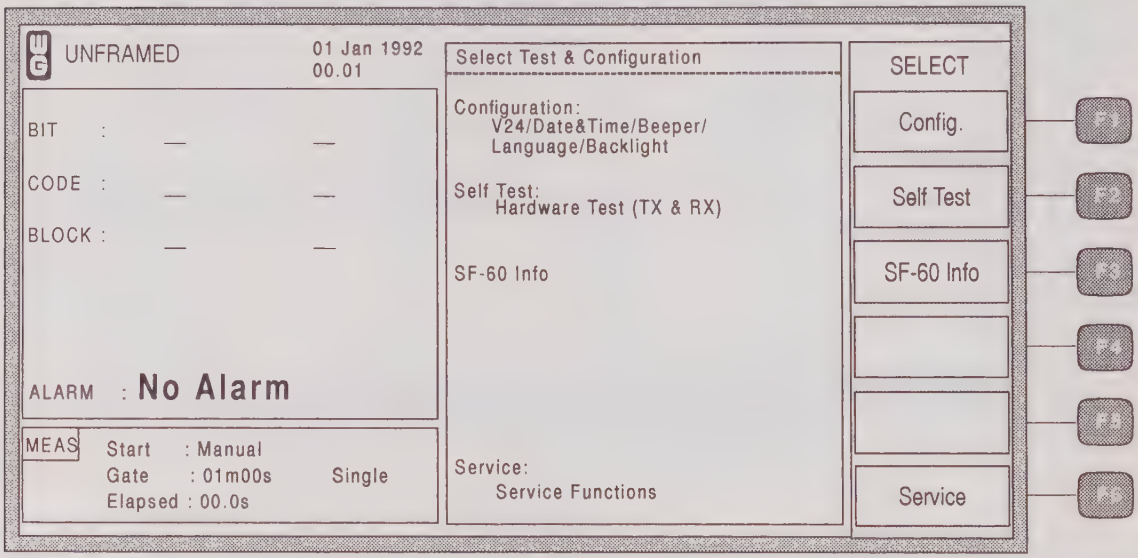


Fig. 3-91 "Test & Configuration" menu, "Unframed Error Test" 140 Mbit/s

The "Test & Configuration" menu gives access to the following functions:

- Set device configuration (key [1] Config., see figure 3-92)
  Specify the V.24 interface parameters
  Alter the date and time settings
  Set the beeper function
  Select the menu language (English or German)
  Set the backlight level for the display
- Start the function check program (key [2] Self Test, see figure 3-93)
  Select all tests or single test
  Select number of self-test cycles (single/repetitive)
  Display test number / test cycle number / status for the test in progress
- Display SF-60 information (key [3] SF-60 Info, see figure 3-94)
  Hardware serial number
  Options fitted
  IEEE 488 bus address of SF-60
  Software version
- Service functions (key [6] Service; for service personnel only. See figure 3-95)

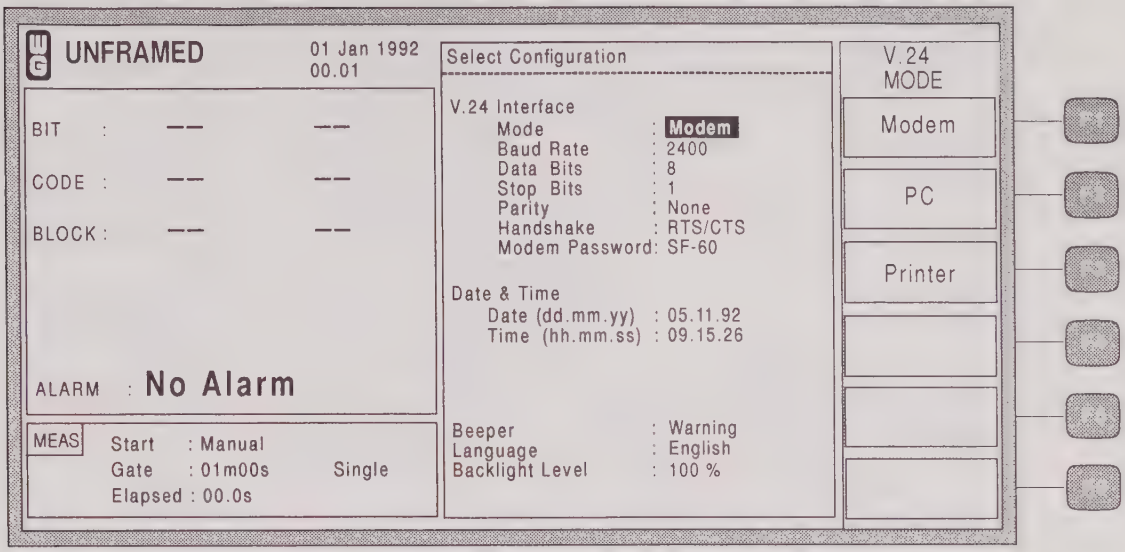


Fig. 3-92 "Test & Configuration" menu display, [1] "Configuration"

The "Configuration" menu page gives access to the following functions:

- For the V.24 interface:
  Select V.24 mode (Modem/PC/Printer (external), default setting: Modem)
  Select baud rate (300/600/1200/2400/4800/9600, default setting: 2400)
  Set number of data bits (7/8, default setting: 8)
  Specify parity (even/none/odd, default setting: none)
  Specify number of stop bits (1/2, default setting: 1)
  Set handshake mode (RTS/CTS = Hardware handshake / Xon/Xoff = Software handshake; default setting: RTS/CTS)
  Enter modem password (max. 19 characters)
  Alter the date and time settings default setting: SF-60)
  Enter the date and time
  Set the beeper function (Off/Warning/Event & Warning, default setting: Warning)
  Select the menu language (English or language installed in the instrument version)
  Set the backlight level for the display (100%/70%/50%, default setting: 100%)

The possible selections available for these parameters are found in the "Test & Configuration" menu tree in section 3.1.4.

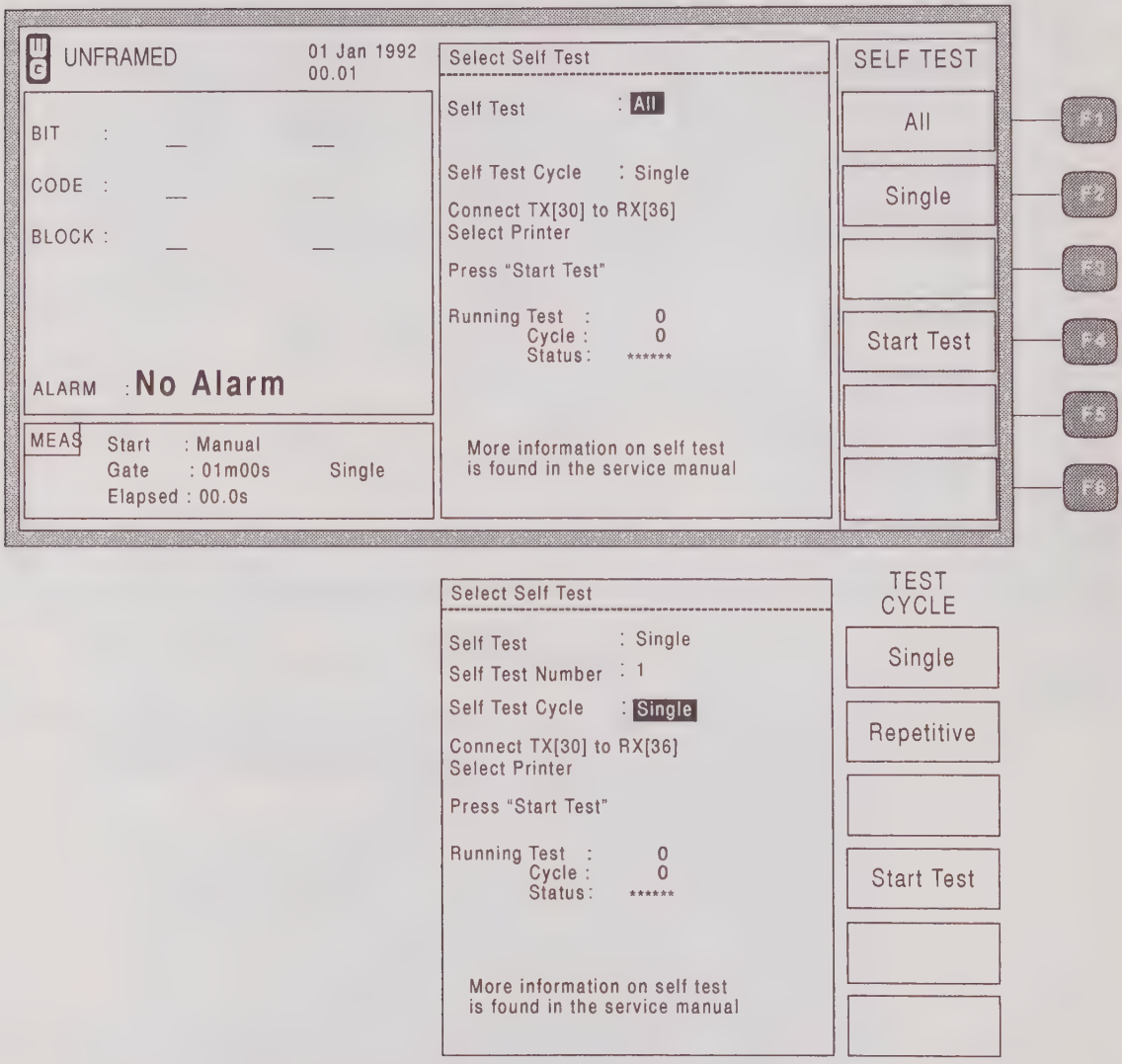


Fig. 3-93 "Test & Configuration" menu display, [2] "Self Test"

The "Self Test" menu page gives access to the following functions:

– Select all tests or single test (All/Single, default setting: All)

– Select self-test number (if "Single" selected)

– Select number of self-test cycles (Single/Repetitive, default setting: Single)

When the self-test is running, the number of the test currently being performed and the number of the test cycle are shown under "Running".

The test numbers and corresponding test types are given in section 2.4.3 "Switching on".

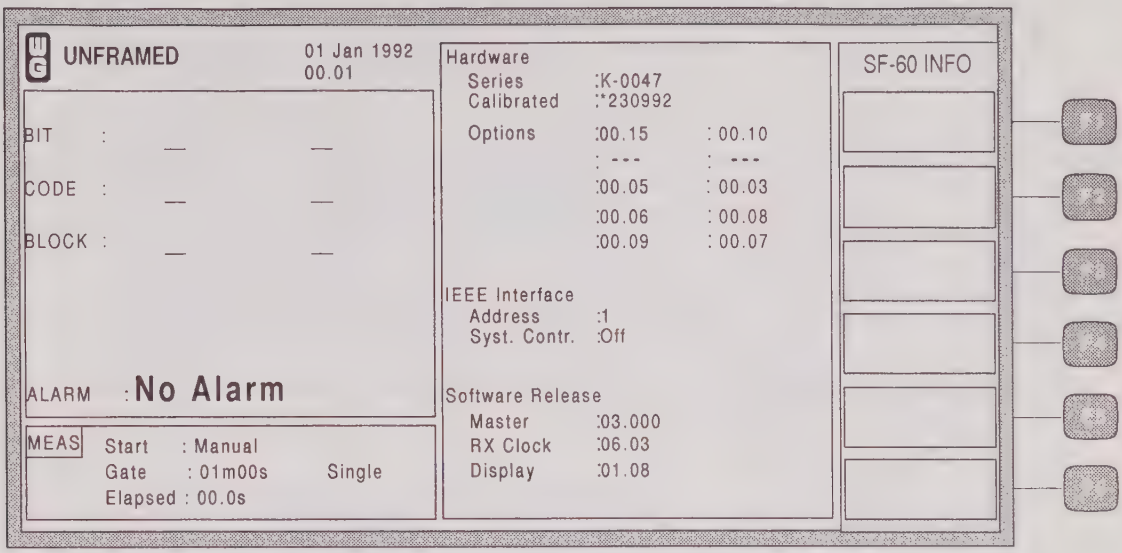


Fig. 3-94 "Test & Configuration" menu display, [3] "SF-60 Info"

The "SF-60 Info" menu page gives the following information on your instrument:

Hardware:

- Instrument serial number
- Date of last calibration (in figure 3-94: Calibrated 23.09.92)
- Option numbers of the options fitted in the instrument:

00.02	Optical interface, 1310 nm
00.03	SDH STM-1 C12 Frame
00.05	SDH STM-1 C4 Frame
00.06	SDH STM-1 C3 Frame
00.07	PDH-MUX/DEMUX chain
00.08	PDH 140 Mbit/s Frame
00.09	PDH 2/8/34 Mbit/s Frames
00.10	Quad output (BN 2074/00.10)
00.15	Jitter generator (BN 2074/00.15)
00.52	G.826 analysis

IEEE 488 interface

- Display of the current address set for the SF-60 (in figure 3-94: Address: 1). The instrument address can be altered using the address switch [44] on the back panel.
- Display of the setting of the SC (system controller) switch [44] on the back panel (in figure 3-94: Syst. Contr.: Off). The SC switch is switch no. 6 (right-hand) of the address switch.

Calculation and setting of the instrument address is described in section 4.1.2 "Device address".

Software version

- Display of main processor software version (in figure 3-94: Master: 03.000)
- Display of input circuit clock recovery processor software version (in figure 3-94: RX Clock: 06.03)
- Display of display processor software version (in figure 3-94: Display: 01.08)

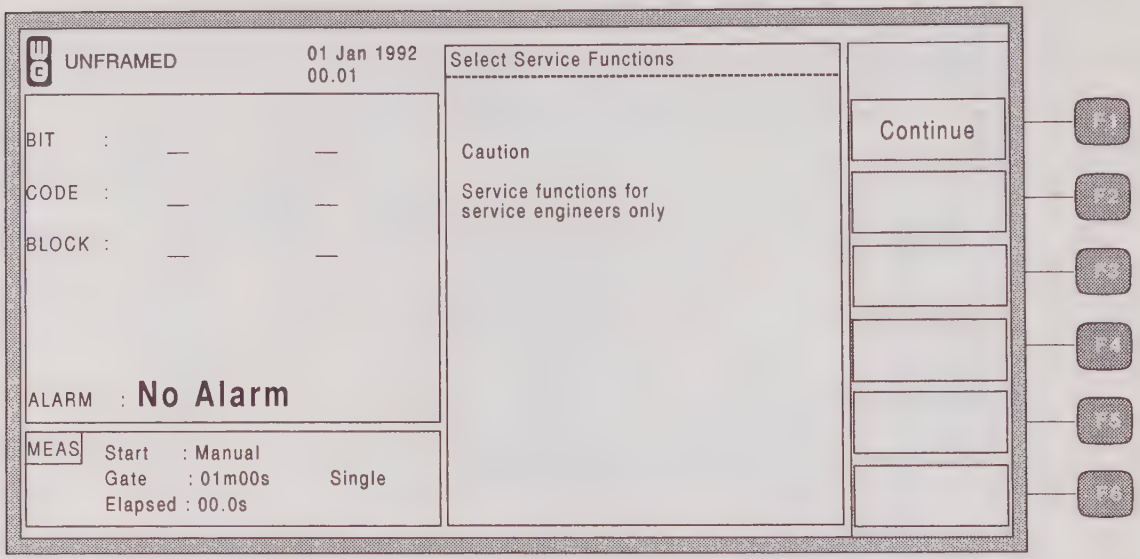


Fig. 3-95 "Test & Configuration" menu display, [6] "Service"

Warning: The "Service" menu functions should only be used by trained, experienced service engineers.
More information on these functions is contained in the SF-60 service manual.

3.4 Error messages

3.4.1 General information

Initialization of the SF-60

If the SF-60 controls are disabled and switching the instrument off and then on again does not alter the situation, initializing the instrument may be useful.

For this, first switch the instrument to standby mode: A.C. line switch [H] is on and standby switch [D] off (switch panel shows black and yellow LED "STANDBY" is on).

Press and hold down the CLR key [11] and switch the instrument on again using the standby switch (switch panel shows red and yellow LED "STANDBY" is off). The CLR switch is located above the ENTER and EXP keys on the right of the number keypad.

It is important that the CLR switch is kept pressed until writing appears on the display (takes about 4 seconds).

3.4.2 Error messages, warnings and status messages

Error messages are output on the display or via the remote control interface.

Warnings are only shown on the display (error numbers 700 to 799).

Device status messages are inserted into the current display page.

Printer messages are output by the printer.

3.4.2.1 Error messages (1)

No.	Error type	Error text
100	Format errors	Unknown command
101		Syntax error
102		Command too long
103		Command too short
104		Data syntax error
105		Illegal data range
106		Illegal input
107		Too many parameters
108		Illegal pattern length
109		Missing parameters
120	Operator errors (manual operation only)	Key disabled
121		Entry disabled
123		Entry disabled as TX pattern is 2x8 bit word
124		Entry disabled as pattern AIS is on
125		Entry disabled as error ratio is not 1 E- ...

No.	Error type	Error text
141	Device type and version errors	Setting impossible as option board not fitted
142		Frequency not possible as modulation generator not fitted
143		Optical interface not fitted
144		Setting disabled as option 3017/00.05 not fitted
145		Setting disabled as option 3017/00.03 not fitted
146		Setting disabled as option 3017/00.06 not fitted
147		Setting disabled as option 3017/00.08 not fitted
148		Setting disabled as option 3017/00.09 not fitted
149		Setting disabled as option 3017/00.07 (MUX/DEMUX chain) not fitted
150		Application not possible as option 3017/00.52 (G.826) not fitted.
160	Setup errors	Memory position is free
161		*Store* disabled during printout of setup
162		Setup(s) being printed out
163		Setup incompatible with options fitted
164		Memory position occupied. Use *Delete* to clear
180	General operator errors	Request disabled
181		Not possible during measuring. Press *Stop* key to end measurement.
182		Not possible in remote mode
183		Not possible as G.821 evaluation is on
184		Not possible as print in diagram mode
185		Disabled during printout. Press *Stop/Paper* key to end printout
186		Printing stored results
189		Entry disabled as Performance Analyzer is not "OFF".
200	Memory card errors	Write access to Memcard impossible. Card write-protected or defective
201		No Memcard
202		Memcard not formatted
203		Formatting error. Wrong device?
204		Insufficient Memcard memory
205		Position is occupied
206		Memcard disabled as option not fitted
207		Memcard position free
220	TX/RX mode errors	TX/RX coupling incompatible with 2x8 bit TX pattern
221		TX/RX coupling incompatible with MUX/DEMUX test application
222		TX/RX coupling incompatible with extended TX bit rate range
240	TX bit rate errors	TX bit rate setting disabled as TX clock source is external
241		RX bit rate setting disabled as RX clock source is external
242		RX clock slope disabled as RX clock generated internally
243		TX bit rate setting disabled due to application selected
244		RX bit rate setting disabled due to application selected

No.	Error type	Error text
261	Measurement mode setting errors	CRC error measurement disabled as application is not PDH 64k/2 CRC.
262		Stuffing rate measurement disabled due to application selected
263		Measurement disabled as TX pattern is 2 X 8 bit word
264		Slip measurement disabled. See TX/RX bit rate and pattern
265		Delay measurement disabled. See TX/RX bit rate and pattern
266		Code error measurement incompatible with codes RZ or NRZ
267		FAS bit error measurement requires SDH application
268		CRC error measurement disabled due to application selected
269		G.821 measurement incompatible with counter measurement modes
270		FAS error measurement disabled due to application selected
271		Stuffing rate measurement incomp. with application selected
272		Output event "Trib. Clock" incomp. with select. RX frame system
273		Output event "2 Mbit/s" incompatible with selected RX frame system
274		FAS bit error/word error measurement only possible across 1 DEMUX hierarchy
275		All FAS bit error/word error measurement only possible across several DEMUX hierarchies
276		Application not possible as frame is off.
280	Jitter errors	Jitter generation incompatible with TX bit rates below 704 kbit/s
300	Code/input circuit errors	TX code is incompatible with TX bit rates above 80 Mbit/s
301		TX amplitude fixed as TX code is ECL or CCITT
302		Modified decoding incompatible with RX codes RZ, NRZ or AMI
303		Modified code error evaluation disabled as RX code is RZ or NRZ
304		RX sensitivity "Auto Sense" disabled as optical interface is on
306		Nominal amplitude fixed as equalizer is off
307		RX code CMI OPT.incompatible with RX bit rates above 175 Mbit/s
308		TX code CMI OPT.incompatible with TX bit rates above 175 Mbit/s
309		Sample threshold selection incompatible with RX codes ECL/ CCITT/OPT.
310		RX code incompatible with RX bit rates above 80 Mbit/s
312		Modified code error evaluation disabled as measurement not code error mode
314		RX sensitivity "Auto Sense" disabled as equalizer is active
315		Nominal amplitude fixed as RX code is ECL
316		Signal input overload. Disconnect signal input
317		Clock input overload. Disconnect clock input
318		Signal and clock input overload. Disconnect inputs
319		Active equalizer incompatible with optical or balanced interfaces
320		Optical interface required for laser on
321		RX input sensitivity incompatible with RX code
322		RX input sensitivity incompatible with external RX clock source
323		RX input sensitivity with RX system bit rates and codes only
324		External RX clock source incompatible with RX sensitivity PMP
325		TX code incompatible with TX bit rates other than 2048 kbit/s
326		Optical interface is incompat. with TX bit rates below 20 Mbit/s.
327		RX code incompatible with RX bit rates other than 2048 kbit/s
328		Optical interface incompatible with RX bit rates below 20 Mbit/s

No.	Error type	Error text
350	Error insertion and pattern errors	Entry disabled as TX pattern is not 2 x 8 bit word
351		Error measurement incompatible with TX pattern 2 x 8 bit word
352		TX pattern 2 x 8 bit word incompatible with framing on
353		Pattern inversion disabled
354		Code error insertion incompatible with TX code
355		Frame error insertion incompatible with unframed error test/ MUX test
357		Code error insertion disabled as error type is not code error
358		TX pattern 2 x 8 bit word incompatible with jitter on
359		Only error insertion generator "frequency" or "jitter on" permitted
360		CRC error insertion incompatible with unframed error test or MUX test
361		CRC error measurement disabled as application is not PDH64K/2 CRC
362		Microinterrupts disabled as TX code is not ternary
363		Error insertion generation incompatible with error insertion type
364		Selected SDH error insertion incompatible with mapping C4
365		Selected SDH error insertion incompatible with mapping C12 bit_sync
366		Selected SDH alarm insertion incompatible with mapping C4
367		Selected SDH alarm insertion only compatible with mapping C12
368		Error insertion impossible as alarm insertion is on
369		Selected SDH error insertion only compatible with mapping C12
370		Selected error insertion incompatible with error generation N frames
371		Error insertion generation incompatible with error insertion type
372		Pattern AIS incompatible with TX pattern 2 x 8 bit word
373		TX pattern 2 x 8 bit word incompatible with pattern AIS
374		TX pattern 2 x 8 bit word incompatible with TX/RX coupling
377		SDH error insertion impossible without SDH frame
378		Error insertion generation incompatible with error insertion type
379		Bit error insertion incompatible with error insert. generation M in N
380		Code error insertion incompatible with error insert. generation M in N
381		Block error insertion incompatible with error insert. generation M in N
382		CRC error insertion incompatible with error insert. generation M in N
383		Microinterrupts disabled as error insertion generation not "single"
384		STM slip error insertion incompatible with error generation M in N
386		CRC/E bit error insertion not possible as CRC disabled
387		Frame error type not possible with current TX frame system

No.	Error type	Error text
420	Framing errors	Framing impossible with this version of the SF-60
421		Framing disabled as TX pattern is 2 x 8 bit word
422		TX tributary/TS selection disabled due to application selected
423		RX tributary/TS selection disabled due to application selected
424		Frame AIS disabled due to application selected
425		Frame AIS disabled due to application selected
426		No pattern in idle TS selectable due to application selected
427		Bits 13 to 16 disabled due to selected application
428		TX NFAS bits disabled due to application selected
429		Bits 11 and 12 disabled due to application selected
430		Bits 13 to 16 disabled as application is not PDH 34/140
431		TX NFAS bits disabled due to application selected
432		Bits 11 and 12 disabled due to selected application
433		Octet in idle TS not possible as application is not PDH64k/2 CRC.
434		SDH application required
435		Incompatible with SDH application
436		TS 16 pattern incompatible with MUX application
437		TS 16 pattern only with PDH 64K/2 or PDH 64k/2 CRC application
438		Sa pattern incompatible with application selected
439		Sa pattern incompatible with application selected
440		Frame manipulation impossible as frame is off
441		SDH overhead manipulation impossible on parity bytes B1/B2/B3
442		Selected SDH overhead byte can't be member of a TX/V11 pattern group
443		Selected SDH overhead manipulation incompatible with selected alarm type
444		Selected SDH overhead manipulation incompatible with selected error type
445		Selected frame manipulation only compatible with PDH frames
446		Selected SDH alarm insertion incompatible with alarm generation N SECONDS
447		Selected SDH alarm insertion incompatible with alarm generation N FRAMES
448		SDH alarm insertion: Cycle must be longer than duration
449		RX clock source external incompatible with SDH application EXCH./MUX
450		TX clock source external incompatible with SDH application EXCH./DMUX
451		Selected SDH setting incompatible with application UNFRAMED/MUX
452		Selected SDH setting incompatible with application UNFRAMED/DMUX
453		Free channel pattern insertion incompatible with mapping C4
454		Illegal byte position in SDH sequence
455		Selected SDH overhead manipulation only compatible with mapping C12
456		Selected SDH overhead manipulation incompatible with alarm insertion
457		Levels of input / output for MUX/DEMUX chain incompatible
458		Selected tributary incompatible with current frame system

3.4.2.2 Error messages (2): Automatic measurement sequence errors

No.	Error type	Error text
501	Operating errors	Start max.tol.jitter measurement disabled as pattern AIS is on
502		Start max.tol.jitter measurement disabled as error insertion active
503		Max.tol.jitter measurement incompatible with counter measurement modes
504		Max.tol.jitter measurement disabled as gate range format is not 'sec'
505		Max.tol.jitter measurement incompatible with TX pattern
506		Start max.tol.jitter measurement disabled as jitter modulation is off
507		Start max.tol.jitter meas. disabled as jitter freq. extern. generated
508		Start max.tol.jitter measurement disabled as frame AIS is on
509		Start max.tol.jitter measurement disabled as measurement repetitive
510		Max.tol.jitter measurement disabled as G.821 evaluation is on
511		Max.tol.jitter measurement disabled as evaluation mode ratio is on
512		Max.tol.jitter measurement disabled. Start freq. above stop frequency
513		Max.tol.jitter measurement disabled as start freq above 0.1 * TX bit rate
516		Start measurement disabled as printer threshold is on
517		Start max.tol.jitter measurement disabled as print in diagram mode
520		Start disabled as print in diagram mode
521		Finish max.tol.jitter measurement first
522		Selected auto mode incompatible with actual framing parameters
523		Start disabled as error insertion is on
524		Start disabled as alarm insertion is on
525		Start disabled as jitter generation is on
526		Start disabled as SDH overhead evaluation is on
527		Start disabled as TU pointer evaluation is on
533		Entry disabled as function check program (FCP) on
540		Illegal test number
541		Setting only possible with frame systems compatible with software version V 2.x
550	Run errors	Measurement aborted as alarm duration too long
551		Measurement aborted as d.u.t. not suitable for measurement

No.	Error type	Error text
570	Sequence errors	Sequence not yet ended
571		Sequence range impossible
572		Memcard required for sequence range
573		Cannot execute sequence as Memcard is not formatted
574		Insufficient Memcard memory
575		Memcard not SF-60 format
576		Cannot execute sequence range. Position free
580		No Memcard
581		Illegal Memcard format
582		No further data available
583		No previous data available
584		Invalid result number
585		Request impossible as result memory is empty
586		Request impossible as no suitable data available
587		Request impossible with current option boards fitted

3.4.2.3 Remote task errors, device status messages (remote controlled operation)

No.	Error type	Comment
600	RMT task error	Output buffer overflow
601		Result mask too long
602		Invalid result mask
603		Invalid result mask
604		Unknown Common Command
614		Program message unit too long
615		Parameter: Syntax error
616		Parameter: Outside value range
617		Parameter not available
618		Cannot set learn string when printer running
619		Learn string: Wrong version code
620		Learn string contains invalid data
621		Learn string: Incorrect length
622		Block length Arbitrary Prog.
623		Block header Arbitrary Prog. Data
624		Recursion Arbitrary Prog. Data
625		Cannot change display mode by remote control

651	Device status	TX synthesizer unlocked
652	messages	No single error insertion
656		Out of paper

3.4.2.4 Warnings

No.	Error type	Error text
701	Warnings (error numbers and comments only relevant to remote control mode)	2 x 8 bit switching frequency is 0.02 * TX bit rate
702		Interface changed for frame operation (comment)
703		Max. error insertion rate exceeded (comment)
704		Decrease input level
705		Increase input level
706		Max. nominal amplitude for attenuator setting (comment)
709		Gate interval limited to 200 ms
710		34 Mbit/s equalizer. RX bit rate and equalizer do not correspond
711		140/155 Mbit/s equalizer. RX bit rate and equalizer do not correspond
712		Frame preset affects TX/RX codes and patterns
714		Slip measurement not possible as measurement range exceeded
715		Delay measurement not possible as measurement range exceeded
716		Jitter modulation too high. Reduce jitter frequency and/or amplitude
717		Jitter modulation too high. Reduce jitter amplitude
718		Jitter modulation too high. Reduce jitter frequency
719		Jitter modulation frequency too low (comment)
720		Burst and burst period limited by bit rate (comment)
721		Burst duration/error rate limited by bit rate (comment)
722		Error ratio limit. Check TX bit rate and burst duration
723		Error frequency limit. Check TX bit rate and burst duration
724		Burst duration limited by bit rate/error rate (comment)

3.4.2.5 Software errors

No.	Error type	Comment
800	Program sequence errors	Sample sequence not run correctly
801		Software error in CASE structure
802		Unknown parameter conversion
803		Inconsistent device setting
804		Incorrect parameter combination in pp_

820	Task communication errors	Unknown task command
821		Task command: Syntax error
822		Task command not allowed at this time
823		Incorrect communication: HWE INM task

3.4.2.6 Hardware errors

No.	Error type	Comment
900	Hardware errors	Cannot read PIO Ctrl register
901		Cannot start ADC
902		Timeout in TRW channel

3.4.2.7 Error messages after switching on

Error type	Display	Message[1] LEDs	Message[1] Beep	Device behavior
Display	-------	Flashes	10-15x	Disabled
ROM	Test: ROM Failure!		2 x	
RAM	Test: RAM Failure!		3 x	
Keyboard	Test: Keyboard Interface Failure!		4 x	
Key stuck	Test: Keyboard Failure!		4 x	
10 MHz clock	Test: System Tick Failure!		5 x	
Clock	Test: Real Time Clock Failure!		6 x	
Input circuit	Test: RX Failure (TIMEOUT)!		7 x	
Input circuit	Test: RX Failure (ROM)!		7 x	
Input circuit	Test: RX Failure (RAM)!		7 x	
Battery	Test: Battery down!	------	1 x	Enabled after 2 seconds
Data loss	Test: Data loss!			
Battery + Data loss	Test: Battery down / Data loss!			
IEEE	Test: GPIB System controller not implemented![2]			
MODEM	Test: MODEM Interface Failure!			

1. Status indicated by flashing of all LEDs on front panel and by beeper (Beep)
2. Appears if SC = ON but controller software not implemented.

3.4.2.8 Printer messages

After switching on:

Error messages/warnings Printer output	Meaning
BASIC INITIALIZATION SET DATE AND TIME PLEASE	Appears if CLR pressed during switch-on
BATTERY DOWN BASIC INITIALIZATION SET DATE AND TIME PLEASE	Appears if battery voltage < 2.2 V
DATA LOSS CHECK: 0000 5555 0000 0000 BASIC INITIALIZATION SET DATE AND TIME PLEASE	Appears if device error occurs (data retention)
BATTERY DOWN DATA LOSS CHECK: 0000 5555 0000 0000 BASIC INITIALIZATION SET DATE AND TIME PLEASE	Appears if device error occurs (data retention) and battery voltage < 2.2 V

During operation:

Error messages/warnings Printer output	Meaning
POWER FAIL	Appears if a.c. power fails momentarily
WARNING Instrument temperature too high Switch off instrument and refer to manual	Appears if instrument overheats (see section 8.11.2)
WATCHDOG ALARM BASIC INITIALIZATION ENTER DATE AND TIME PLEASE	Device error (software)
ALARM BUFFER OVERFLOW	The alarm buffer contains more current alarms than can be handled by the printer

4 Remote control

Overview

The SF-60 is a microprocessor-controlled device. All device functions and parameters which can be set manually can also be set by remote control from an external control computer.

The instrument is equipped with two built-in remote control interfaces for this purpose:

- Interface to GPIB
- Interface to RS-232

The main advantages of the RS-232 interface are:

- Control possible over long distances (point-to-point / modem)
- Control using a PC without additional GPIB interface board.

The main advantages of the GPIB interface are:

- High-speed data transmission
- Measurement system capability (multipoint connection).

Remote control behavior

Remote control behavior is based on ANSI / IEEE standard 488.2-1987. The new IEEE 488.2 standard provides greater transparency and standardization of the functions performed via the interface. It also simplifies the creation of clear user programs.

The programming instructions in section 4.3 "Program instructions" apply to both remote control interfaces. Programs written for the GPIB or the RS-232 interface can be interchanged simply by exchanging the appropriate driver routines.

Differences between GPIB and RS-232

The GPIB remote control interface is a control bus system to which "Talkers" and "Listeners" are connected. The RS-232 remote control interface is a full duplex connection enabling data transfer in both directions simultaneously.

GPIB interface functions are not implemented by RS-232, but some functions can be simulated by RS-232 (see section 4.2.1, "Remote control interface functions").

Program examples

To simplify the introduction to programming the SF-60, some example programs for setting and polling the SF-60 are included. A good working knowledge of how the SF-60 is operated manually will also be of assistance when programming the instrument.

Please note the following useful feature:

If the parameter "Printer/Remote Command is selected, the printer outputs a printout of the remote control command corresponding to each operating step performed.

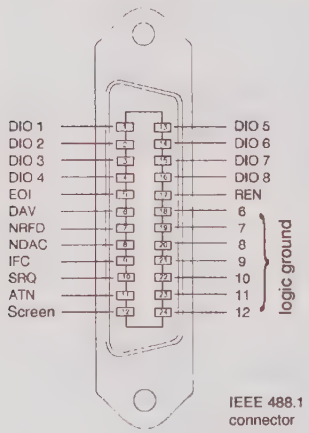
4.1 The GPIB remote control interface

4.1.1 Bus connections

The built-in GPIB remote control interface is equipped with a standard 24-way connector with the pin configuration shown in figure 4-1. GPIB cables of various lengths are available for connecting the SF-60 to other instruments and to the bus controller:

- 1.2 m long: **K 420**
- 2.0 m long: **K 421**

The maximum cable run between instruments is 4 meters.



DIO 1 ... DIO 8 = Input / Output
EOI = End or Identify
DAC = Data Valid
NRFD = Not Ready for Data
NDAC = No Data Accepted
IFC = Interface Clear
SRQ = Service Request
ATN = Attention
REN = Remote Enable

Fig. 4-1 Pin connections of the SF-60 IEEE 488.1 bus connector

Up to 15 instruments can be connected to the interface system (see figure 4-2). The maximum cable run used to connect a group of instruments is 20 meters. For more information, refer to the IEEE 488 standard.

Longer distances can be bridged using interface couplers (2-wire or 4-wire connections) or modems.

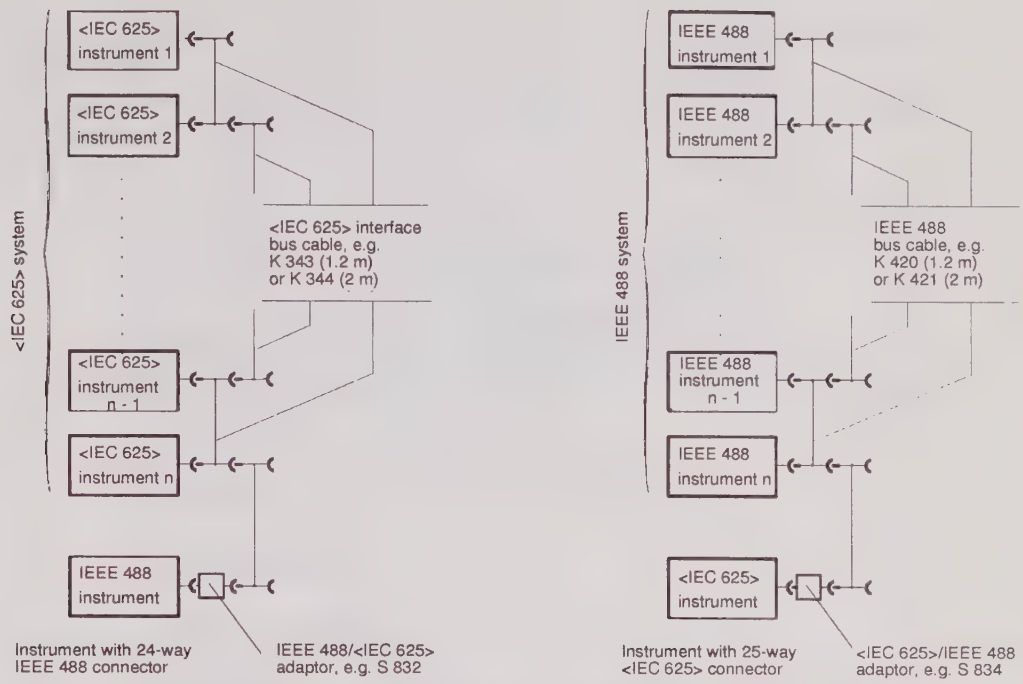


Fig. 4-2 Interconnecting IEEE 488 and IEC 625 bus systems

4.1.2 Device address

To ensure that the controller of the test system addresses the correct instrument, each instrument must be assigned an unique address.

The device address for the SF-60 is set using the switch on the back panel (see figure 4-3). If the address setting is altered, the SF-60 must be switched off and then on again to accept the new setting.

Note: Make sure that a given address is used only once within the interface system. The controller address is reserved for the controller.

Setting and calculating the device address

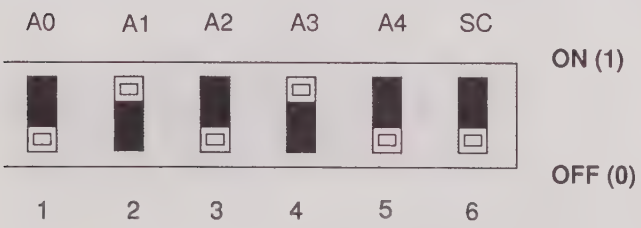


Fig. 4-3 Setting the address switch (back panel of SF-60)

Switch No.	1	2	3	4	5	6
Designation	A0	A1	A2	A3	A4	SC [2]
Setting[1]	0	1	0	1	0	
Value	1	2	4	8	16	

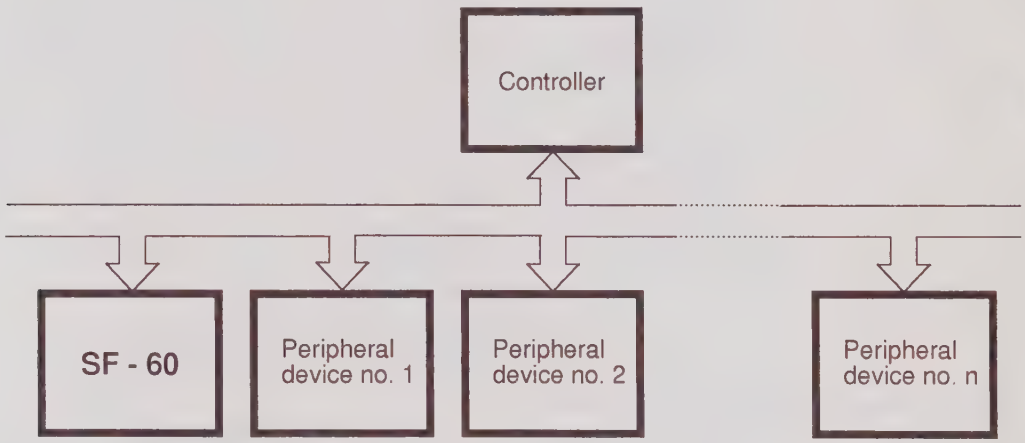
1) Example setting = Address 10 (binary 01010); Values 2 + 8 = 10

2) SC = System Controller (function reserved for future use)

31 different addresses can be set (0 to 30 inclusive).

Address no. 31 is used as an internal reset command for the listener function (unlisten).

A maximum of 15 instruments can be connected to the bus system.



GPIB address = n

SC = OFF

Fig. 4-4 Configuration of a test system with controller

4.1.3 Interface functions (IEEE 488.1)

Figure 4-5 indicates the interface functions available in the SF-60. They conform to the IEEE 488.1 standard.

Further information is found in the Wandel & Golterman brochure "SCPI and IEEE 488" available on request (Order number E11.94/WG1/134/5.0).

Function		Comment
SH 1	Source Handshake	Source Handshake; full implementation
AH 1	Acceptor Handshake	Acceptor Handshake; full implementation
T 6	Talker	Talker; all functions except "Talker Only"
L 4	Listener	Listener; all functions except "Listener Only"
SR 1	Service Request	Service Request; full implementation
RL 1	Remote / Local	Remote/Local; full implementation. Local operation disabled with Local Lockout command
PP 1	Parallel Poll	Parallel Poll
DC 1	Device Clear	Device Clear; full implementation
DT 1	Device Trigger	Device Trigger; full implementation

Fig. 4-5 Overview of SF-60 interface functions

4.2 The RS-232 remote control interface

The SF-60 is equipped with a RS-232 interface in addition to the GPIB interface.

The SF-60 can be remote-controlled via this serial interface or via the GPIB interface.

The advantages of each interface and the basic differences are indicated in section 4.1.

4.2.1 Interface functions

The GPIB interface functions are not implemented by RS-232, but the following functions can be simulated by RS-232:

GPIB command	RS-232 simulation
Service Request (SRQ)	A special character (<BEL> = 07hex) is transmitted to the controller in the event of a SRQ
Device Clear (DCL)	DCL is triggered by transmitting a BREAK signal to the SF-60
Remote/Local (RL)	Simulated by the RS-232 command "REMOTE ON (OFF)"
Local Lockout (LLO)	Simulated by the RS-232 command "LOCK ON (OFF)"

Fig. 4-6 Simulation of GPIB commands

The following functions cannot be simulated:

- Parallel Poll (PPC/PPU)
- Serial Poll (SPE/SPD)

Transmission error check

Serial data transmission over long distances is subject to errors if no precautions are taken to protect the data. The SF-60 provides optional facilities for communication using a data protocol and CRC routine for eliminating transmission errors.
The CRC routine detects errors within a given data block.
The protocol ensures that data communication is automatically repeated until the data block is correctly received.

4.2.2 Bus connections

The serial interface is defined by two ITU-T recommendations:

- V.24 Interface circuits
- V.28 Electrical characteristics

The V.24/V.28 or RS 232 standard was originally applied to the interface between a digital signal processing device and a modem.

Digital signal processing

DTE = Data Terminal Equipment

Modem

DCE = Data Communication Equipment

Apart from this application, it can also be used to define the interface between two instruments not connected via modems.

The SF-60 can be connected as follows:

- To a modem (25-way connecting cable)
- To a PC (25-way connecting cable)
- To a PC (9-way connecting cable)
- To a PC (3-way connecting cable)
- To an external printer (25-way connecting cable)

Connection to a modem

The SF-60 is directly connected to the modem with a 25-way 1 to 1 cable.

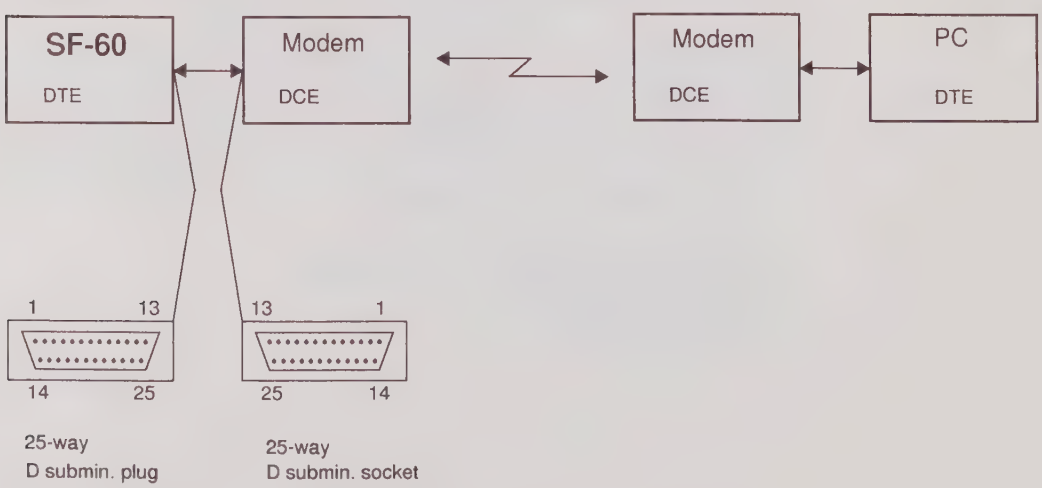


Fig. 4-7 Connection to a modem

Pin	DIN 66020	ITU-T V.24	EIA RS 232	Description		Direction	
						SF-60	Modem
1	E1	101	AA	PG	Protected Ground	-	-
2	D1	103	BA	TXD	Transmit Data	Out	In
3	D2	104	BB	RXD	Receive Data	In	In
4	S2	105	CA	RTS	Request To Send	Out	In
5	M2	106	AB	CTS	Clear To Send	In	Out
6	M1	107	CC	DSR	Data Set Ready	In	Out
7	E2	102	AB	SG	Signal Ground	-	-
8	M5	109	CF	DCD	Carrier Detector	In	Out
20	S1.2	108.2	CD	DTR	Data Terminal Ready	Out	In
22	M3	125	CE	RI	Ring Indicator	In	Out

Fig. 4-8 25-way connector pin assignments

The modem must be connected to a leased line or operate using the Hayes method. The SF-60 must be able to accept an incoming call. The modem must be set so that it does not break the connection when a BREAK signal (Interface Clear for IEEE bus, ASCII zero) is received. No special functions, such as switching to command mode, may be linked to the DTR signal. These conditions are fullfilled by most modems in their basic state.

Connection to a PC

The SF-60 and the PC function as DTEs in this case. A zero modem is therefore required between the two instruments. The following connections are required:

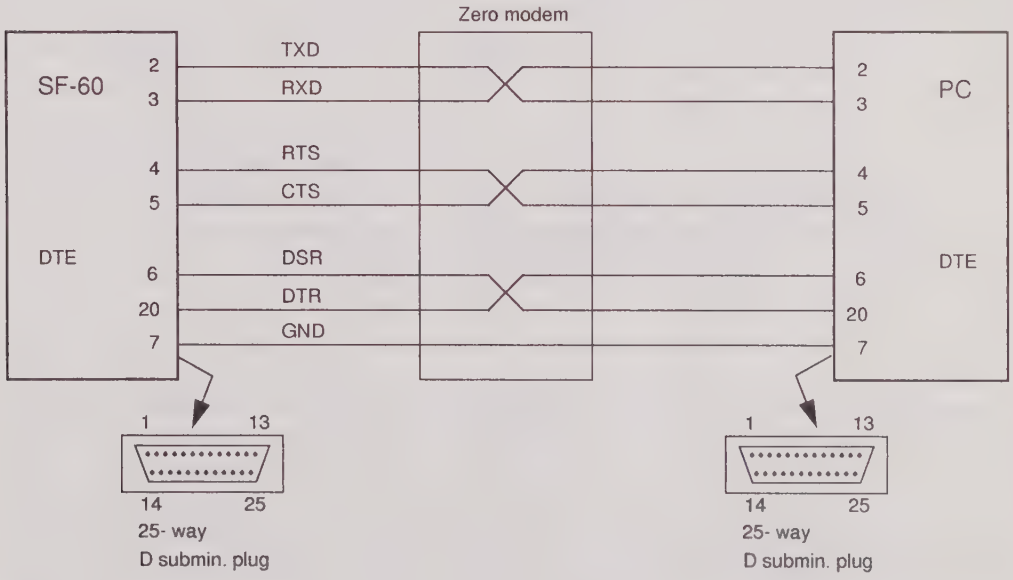


Fig. 4-9 25-way connection

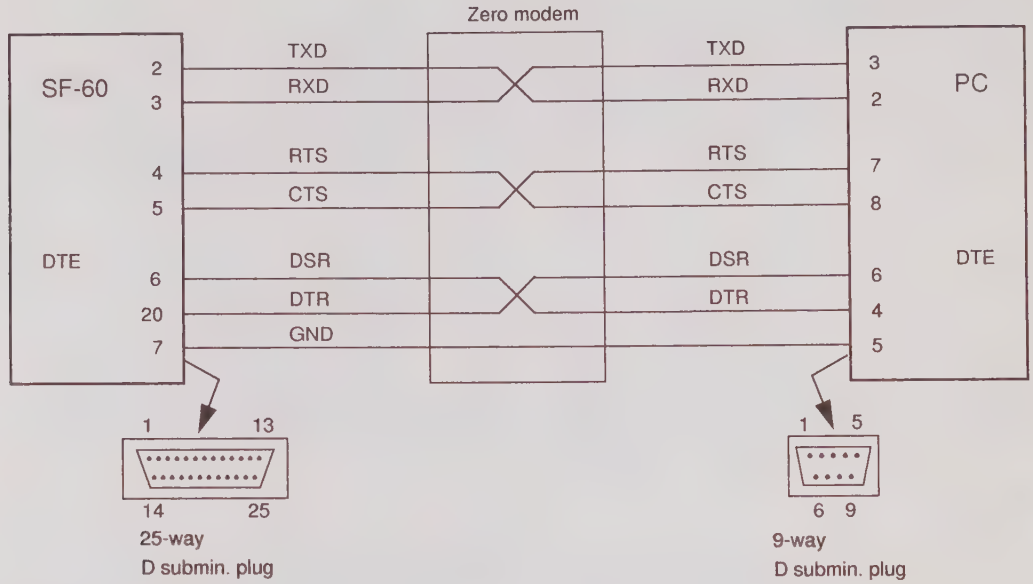


Fig. 4-10 9-way connection

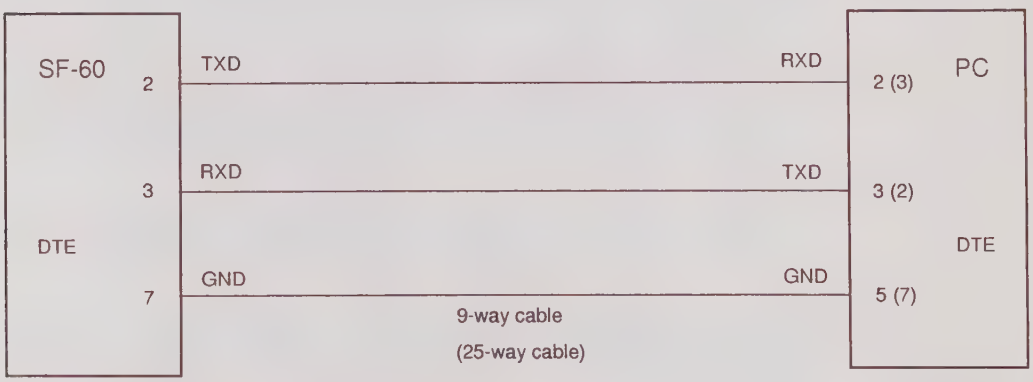


Fig. 4-11 3-way connection (XON/XOFF operation)

Connection to an external printer

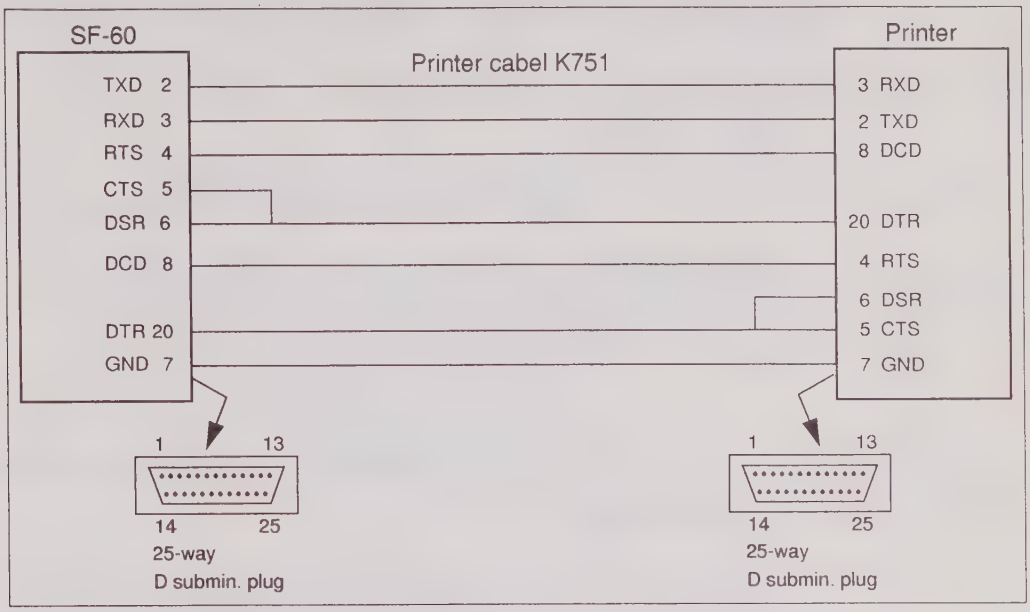


Fig. 4-12 25-way connection

4.2.3 Parameters

The transmission parameters of all instruments must be identical to ensure correct transmission of data across the remote control interface. the parameters are:

– Baud rate: 300, 600, 1200, 2400, 4800, 9600 bit/s

– Parity: even, odd, none

– Number of data bits per character: 7, 8

– Number of stop bits per character: 1, 2

– Flow control: Software handshake XON/XOFF, hardware handshake RTS/CTS.

For remote control, an operating mode for the serial output [45] of the SF-60 must be selected:

- PC: CRC check possible, no protocol and call detection
- Modem: CRC check, protocol, call detection

Password for modem operation

The SF-60 is provided with a password mechanism which can be used to protect the instrument against unauthorized operation when a dial-up modem is used.

The password must be transmitted as the first command.

The password comprises a maximum of 19 characters; it is set using the menu.

As soon as the SF-60 detects an incoming call via the ringing indicator circuit, the instrument remains locked for incoming commands until the valid password is transmitted with the corresponding command or the connection is cleared down.

4.2.4 Data communication

The following data formats are possible, depending on the operating mode selected for the SF60:

PC operation, without data error check

<DATA> ... <EOS>

where <EOS> = <LF> = 0A hex End of string
<DATA> = all characters except the control characters used

Modem operation, with CRC and protocol for data protection

<STX> <DATA> ...<ETX> <CRC> <CRC> <CRC> <CRC> <ETB>

where <STX> = 02 hex Start of text
<ETX> = 03 hex End of text
<ETB> = 17 hex End of block
<DATA> = all characters except the control characters used

Protocol protection

The protocol protection is a mechanism which guarantees the complete transmission of each data block. A data block is a sequence of bytes with either a fixed length or which is indicated by special codes, e.g. start and end characters.

The protocol used in the SF-60 is the simple

Acknowledge (ACK) and Not Acknowledge (NAK) protocol.

It is symmetrical, i.e. transmitter and receiver are interchangeable.

CRC

The checksum used is a 16-bit CRC polynomial for bit-oriented procedures specified by the ITU-T.

The polynomial used is: $x^{16} + x^{12} + x^5 + 1$

The CRC sum is calculated only from the data bits. The CRC sum is converted into a hexadecimal value which is transmitted as ASCII characters with the highest value byte first.

The following algorithm may be used to calculate the sum:

```
   crc = 0
   len = <length of string>
   i = <position of first character>
A: c = <byte in position i>
   q = (crc XOR c) AND 15
   crc = (crc / 16) XOR (q * 4225)
   q = (crc XOR (c / 16)) AND 15
   crc = (crc / 16) XOR (q * 4225)
   i = i + 1
   len = len - 1
   if (len > 0) then goto A
```

Protocol sequence

The protocol sequence is illustrated by a consideration of the following cases:

The transmitter transmits a data block; the receiver detects the end of the block:

- Correct transmission
  The receiver checks the block for completeness and correctness and returns <ACK> to the transmitter.
- Error in data block
  The receiver detects an error and returns <NAK> to the transmitter, which then repeats the transmission.
- Incomplete data block
  The transmitter waits for the response from the receiver, which does not occur within the set time limit (timeout). The transmitter then transmits the <ENQ> (enquiry) signal to the receiver, which then recognizes that the data block was incomplete and returns <NAK> to the transmitter, which then repeats the data block.
- Response missing
  The transmitter waits for the response from the receiver, which does not occur within the set time limit (timeout). The transmitter then transmits the <ENQ> (enquiry) signal to the receiver, which then recognizes that only complete data blocks were received and repeats the response which is missing.

To ensure that the protocol mechanism is timed in each case, the waiting time period can be programmed (see section 4.3 “Programming”).

4.3 Programming

4.3.1 General syntax rules for program commands

(based on IEEE 488.2 / IEC 625-2)

Program commands consist of a program word and parameter(s).
The program word may be composed of several sub-words.
The command structure is hierarchical.
Example:
:G821:PRT:INT1 10MIN;

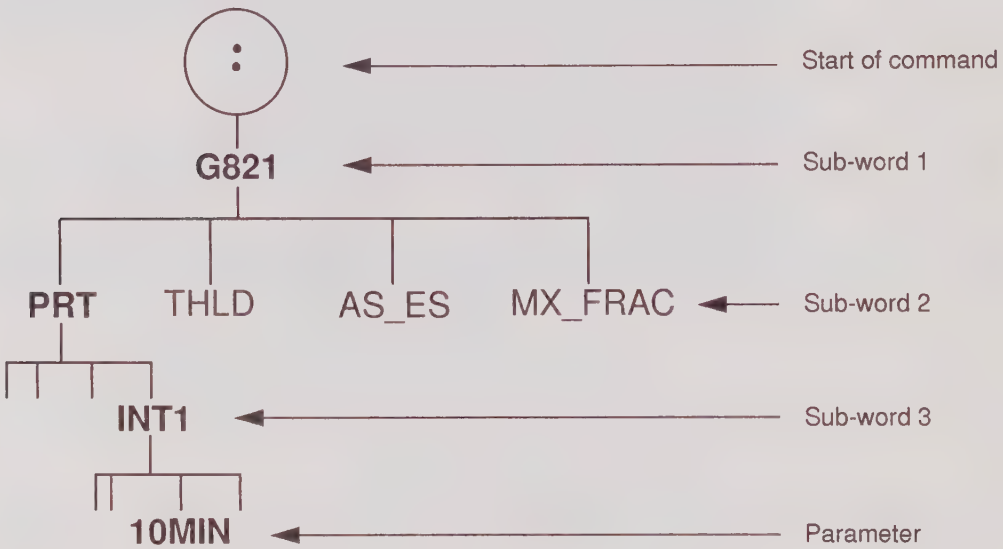
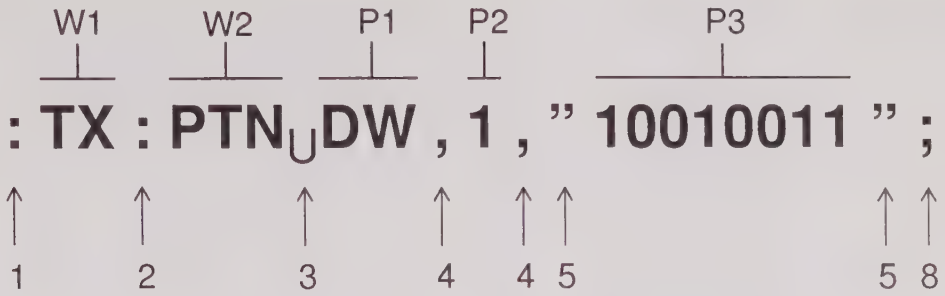


Fig. 4-13 Hierarchical command structure.

Program command structure

1 Compound commands (device-specific) begin with a colon (:), e.g. :START
2 The program word may be composed of several sub-words. The sub-words are separated by a colon (:), e.g. :PRT:THLD:TYPE CNTR1
3 The program word and its parameters are separated by a space (SP) which is represented by the symbol u in this manual.
4 Multiple parameters are separated by commas (,), e.g. :RAMC:DEL 101,102
5 Parameters which are binary numbers are placed within single or double inverted commas (' ' or " "), e.g. :RX:PTN DW,1,"1001000"; or :RX:PTN DW,1,'1001000';
6 If a word or parameter is composed of two terms, these must be linked by an underline (_), e.g. :RX:CLK_SRC SNGL;
7 Common commands begin with an asterisk (*), e.g. *RST;
8 Every program command ends with a semi-colon (;), e.g. :STOP;

Compound (device-specific) command



or

: TX : PTN U DW , 1 , ' 10010011 ' ;

Fig. 4-14 Setting the TX pattern

W1 = Sub-word 1
W2 = Sub-word 2
P1 = Parameter 1
P2 = Parameter 2
P3 = Parameter 3
1 = Start (:)
2 = Sub-word separator (:)
3 = Separator between word and parameter (u)
4 = Separator between multiple parameters (,)
5 = Delimiter character (" or ')
8 = End (;)

Compound (device-specific) command

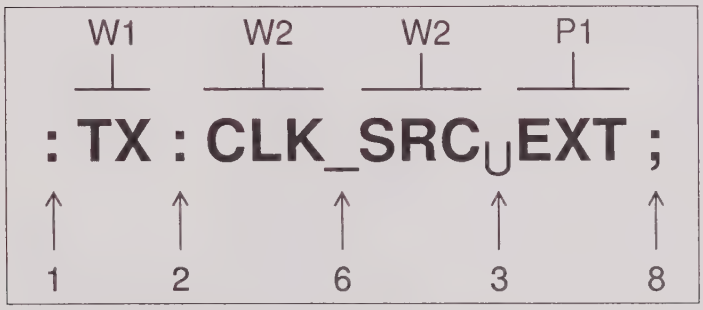
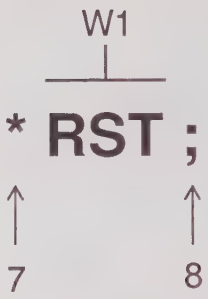


Fig. 4-15 Setting the TX clock source

W1 = Sub-word 1
W2 = Sub-word 2 (two terms)
P1 = Parameter 1
1 = Start (:)
2 = Sub-word separator (:)
3 = Separator between word and parameter (u)
6 = Link between two terms (_)
8 = End (;)

Common command



W1 = Sub-word 1

7 = Common Command (*)

8 = End (;)

Fig. 4-16 Device reset

Shortform entry

Program commands can be shortened.

This is only possible for several commands which are combined within a single output statement addressing a single device as listener. The shortform entry omits the colon in front of the appended command.

Example commands 1 and 2 result in identical settings of the SF-60:

1 :G821:PRT:INT1 10MIN;
:G821:AS_ES ON;
2 :G821:PRT:INT1 10MIN;AS_ES ON;

Query of setting parameters

All queries for commands with setting parameters have the same syntax as the command they query (exception :LRN). The query is distinguishable by the quesion mark (?) placed before the end character (;). The program word and ? must not be separated by a space.

Example:

Transmit bit rate setting to SF-60:

:TX:BITR$_U$139264000;

Query bit rate setting

:TX:BITR?;

4.3.2 Device settings

The program commands are listed in groups in the following tables. The example below explains the contents of these tables.

Program word	Parameter	Query	Explanation
:RIC ␣ U	FREQ,200;	yes	Toggle frequency of Ricar sequence
Parameter 1	EXT; FRACT, FREQ,		External switching via skt [43] Fractional bit rate Frequency in Hz
Parameter 2			Not for EXT
	Frequency;		Any entry: For FREQ: from 10 Hz to 500000 Hz
	Rate;		For FRACT: as nE-m n = 1,2,3 ; m = 4 to 8
			Examples: :RIC␣EXT; :RIC␣FRACT,2E-7; :RIC␣FREQ,1000;

Header

Default setting

Default setting The first line shows the default setting which is made when the instrument is initialized:
:RIC␣FREQ,200;
The program word and parameter(s) are always shown in upper-case (capital) letters.
Please note the space (␣) between the program word and the parameter(s).

Parameter 1 The next line and any following lines show all the possible parameters, in this example: FREQ, / FRACT, / EXT;

Parameter 2 In this example, parameter 2 is a numerical value.
The words "Frequency," and "Rate," stand for any value. The range and units are specified in the "Explanation" column.

Query The word "yes" in this column indicates that the setting can be queried.
:RIC␣FREQ?;

Explanation This column contains a short explanation of the command, the parameter setting range and some examples.

Note: The SF-60 is initialized (default settings) by pressing the "CLR" key while switching the instrument on, and holding it down for about 5 seconds.

Commands

TX / RX mode

Program word	Parameter/Altered in software version:	Query	Explanation
:MODE U	TX_EQ_RX; TX_NE_RX; TX_EQ_RX; RX_EQ_TX;	yes	TX/RX coupling TX_EQ_RX or RX_EQ_TX only effictive if TX_NE_RX set previously

TX settings

Program word	Parameter/Altered in software version:	Query	Explanation
:TX:BITR U	139264000;	yes	TX bit rate Any entry: 48000 Hz to 175000000 Hz
:TX:OFFS U *Parameter 1* *Parameter 2*	0,PPM; *Offset*, PPB; PPM;	yes	TX signal offset Any entry: -999.999 to +999.999 ppb (1E-9) -999 to +999 ppm (1E-6) Example: :TX:OFFS$_U$-454.200,PPB; 0 = calibrated
:TX:CLK_SRC U	INT; EXT; INT; SYNC;	yes	TX clock source External transparent; skt [41] Internal ext. synchronization; skt [41]

TX settings

Program word	Parameter/Altered in software version:	Query	Explanation
:TX:PTN U	PRS23;	yes	TX pattern
Parameter 1	PRS6; PRS7; PRS9; PRS10; PRS11; PRS15; PRS17; PRS19; QRSS; PRB20; PRS20; PRS23; PRS29; PRS31; DW, RIC, OCT,		Examples: :TX:PTN$_U$DW,1,"1001101"; Length of digital word: 1 to 32 bits :TX:PTN$_U$RIC,"1000111000011110"; Length of Ricar sequence: 16 bits :TX:PTN$_U$OCT,"10011100"; Length of octet: 8 bits Digital words 1 to 4 Note: RIC(ar sequence) only for :MODE:TX_NE_RX; Octet
Parameter 2	1, 2, 3, 4,		DW number
Parameter 3	"1 - 0";		Bit pattern for DW, RIC and OCT
:TX:PRS U	NORM; NORM; INV;	yes	Inversion of TX pattern
:TX:AIS_PTN U	OFF; OFF; ON;	yes	TX pattern with AIS on/off
:TX:AMPL U	500;	yes	Amplitude of TX signal (does not apply to balanced and optical TX signals) Any entry: 500 mV to 2500 mV
:TX:LASER U	OFF; OFF; ON;	yes	TX laser source (option)

TX settings

Program word	Parameter/Altered in software version:	Query	Explanation
:TX:CODE U	CMI_CCITT;	yes	TX signal code
	AMI_1_2;		
	AMI_ 1_1;		
	HDB3;		
	B3ZS;		
	NRZ;		
	RZ;		
	NRZ_ECL;		
	RZ_ECL;		
	CMI;		
	CMI_CCITT;		
	CMI_ECL;		
	CMI_I;		
	CMI_I_CCITT;		
	CMI_I_ECL;		
	HDB3_120;		2048 kbit/s only; 3 V fixed amplitude
	NRZ_OPT;		Option 20 Mbit/s to 175 Mbit/s
	CMI_OPT;		Option 20 Mbit/s to 100 Mbit/s
	CMI_I_OPT;		Option 20 Mbit/s to 100 Mbit/s

TX jitter (option)

Program word	Parameter/Altered in software version:	Query	Explanation
:J:TX U	OFF;	yes	Jitter on / off
	OFF;		
	ON;		
:J:AMPL U	0.10E3;	yes	Jitter amplitude setting Any entry (in mUI) in the range: 0.00E3 to 2.49E3 2.5E3 to 20.0E3 *Note*: J:AMPL is coupled to J:FREQ. If the maximum jitter amplitude for a given jitter frequency is exceeded, the maximum value will be set and no Execution Error will be generated.
:J:FREQ U	0.100E3;	yes	Jitter frequency setting Any entry (in Hz): 0.002E3 to 0.999E3 1.00E3 to 9.99E3 10.0E3 to 99.9E3 100E3 to 4500E3 *Note*: J:FREQ is coupled to J:AMPL. If the maximum jitter frequency for a given amplitude is exceeded, the maximum jitter frequency will be set and no Execution Error will be generated.

TX jitter (option)

Program word	Parameter/Altered in software version:	Query	Explanation
:J:MOD U	INT; EXT; INT;	yes	Modulation signal external via skt. [20]

Ricar sequence

Program word	Parameter/Altered in software version:	Query	Explanation
:RIC U	FREQ,200;	yes	Toggle frequency of Ricar sequence
Parameter 1	EXT; FRACT, FREQ,		External via skt [43] Fractional bit rate Frequency in Hz
Parameter 2	 *Frequency;* *Rate;*		Not for EXT Any entry: For FREQ: from 10 Hz to 500 kHz For FRACT: as nE-m n = 1, 2, 5 m = 4 to 8 Examples: :RIC$_U$EXT; :RIC$_U$FRACT,2E-7; :RIC$_U$FREQ,1000;
:TX:ERR_INP U	TTL; ECL; SINUS; TTL;	yes	Control input [43] sensitivity (External error insertion or Ricar sequence switching)

Error insertion

Program word	Parameter/Altered in software version:	Query	Explanation
:ERR:INS U	OFF; OFF; ON;	yes	Error insertion on / off

Error insertion

Program word	Parameter/Altered in software version:	Query	Explanation
:ERR:TYPE U	BIT;	yes	Error type
	BIT;		Bit
	BLC;		Block
	BURST_0;		Zero burst
	BURST_1;		Ones burst
	CODE;		Code
	MI;		Micro-interrupt
			With frame option only
	FAS;		FAS
	3.x		compatible with:
			FAS_2M;
			FAS_8M;
			FAS_34M;
			FAS_140M;
			FAS_STM1;
			With frame option only:
	FAS_2M;		PCM 30
	FAS_8M;		PCM 120
	FAS_34M;		PCM 480
	FAS_140M;		PCM 1920
	FAS_STM;		STM-1
	EBIT;		PCM 30 CRC
	CRC;		PCM 30 CRC
			With STM-1 frame option only:
	B1;		Parity word error
	B1_INV;		B1 parity word inverted
	B2;		
	B3;		
	LP_B3;		C-3
	NDF; 2.x		Compatible with AU_NDF;
	STM_BIT; 2.x		must be replaced by **STM_BYTE;**
	3.x		Compatible with **STM_BYTE;**
			Error in:
	STM_BYTE;		C-4, C-12, C-3 any byte (replaces **STM_BIT;**)
			Error in:
	STM_BYTE_MF;		C-12 multiframe only
	HP_FEBE;		C-4, C-12, C-3
	LP_FEBE;		C-12 asynchronous, C-3
	LP_BIP;		C-12 asynchronous only
	AU_NDF;		C-4, C-12, C-3
	TU_NDF;		C-12 asynchronous, C-3
	STM_SLIP;		C-4-C-12, C-3

Error insertion

Program word	Parameter/Altered in software version:	Query	Explanation
:ERR:GENERAT U	SINGLE;	yes	Error generation
Parameter 1	EXT; INT_FRE; SINGLE; INT_RAT, M_IN_N, FRM_NR,		External via skt [43] Using jitter modulator frequency Only for frame option (single)
Parameter 2	*No. of frames;* *nE-m;* *M,*		Only for FRM_NR Enter any number of frames 1 to 999 Example: :ERR:GENERAT$_U$FRM_NR,1; (see :ERR:FNR_CYCLE$_U$...) Only for INT_RAT Any entry in nE-m n = 1 to 9 m = 2to 8 Example: :ERR:GENERAT$_U$INT_RAT,2E-6; Only for M_IN_N (frame option)
Parameter 3	*N;*		Any entry: M = 1 to 11, N = 1 to 11 M ≤ N Example: :ERR:GENERAT$_U$M_IN_N,1,2;
:ERR:FNR_CYCLE U	EVER,1;	yes	Repetition time for :ERR:GENERAT$_U$FRM_NR, ...;
Parameter 1	ONCE; EVER,		
Parameter 2	*n;*		Any entry in n x 100 msec: n = 1 to 99 (0.1 to 9.9 sec) Example: :ERR:FNR_CYCLE$_U$EVER,10;
:ERR:FREQ U	200;	yes	Frequency for INT_FREQ With jitter option only: Any entry: 2 Hz to 4500000 Hz
:ERR:BURST_TIME U	1.0000E4;	yes	Burst duration/ mirco-interrupt duration Any entry in 0.2 µs: 0.0004E4 to 65.5350E4
:ERR:BURST_NR U	1;	yes	Burst duration / micro-interrupt duration Any entry in kbit: 1 to 32000

Error insertion

Program word	Parameter/Altered in software version:	Query	Explanation
:ERR:CODE U	NORM;	yes	Code error insertion for the codes:
	ALT_11;		CMI
	INV_0;		
	CODE_PTN;		AMI, HDB3, B3ZS, CMI
	CODE_ALL;		HDB3, B2ZS
	NORM;		
:ERR:R_C_B U	1,1,1; 2.x	yes	STM bit position must be replaced with **:ERR:R_C_MASK**
Parameter 1	r,		Row 1 to 9
Parameter 2	c,		Column 1 to 270
Parameter 3	b; 3.x		Bit position 1 to 8 compatible with **:ERR:R_C_MASK**
:ERR:R_C_MASK U	1,1,"IITTTTII";	yes	STM BYTE position (replaces **:ERR:R_C_B** from version 2.x) Any entry:
Parameter 1	*Row,*		Row: 1 to 9
Parameter 2	*Column,*		Column: 1 to 270
Parameter 3	*"Byte;"*		Byte entry: I, T I = inverted, T = transparent Length = 8 characters
:ERR:MF:MASK U	V1,"TTTTITTT";	yes	Multiframe (C-12 only)
Parameter 1	V1,		In asynchronous mode
	V2,		
	V3,		
	V4,		
	V5,		
	J2,		
	Z6,		
	Z7,		
	V1,		
	V2,		In asynchronous mode
	V3,		
	V4,		
Parameter 2	*"Byte";*		Byte entry: I, T I = inverted, T = transparent Length = 8 characters

RX settings

Program word	Parameter/Altered in software version:	Query	Explanation
:RX:BITR U	139264000;	yes	RX bit rate Any entry: 48000 Hz to 175000000 Hz
:RX:CLK_SRC U	SGNL; EXT; SGNL;	yes	RX clock source External via skt [37] From data signal[36]
:RX:SLPE U	POS; NEG; POS;	yes	RX clock signal edge
:RX:PTN U *Parameter 1*	PRS23; PRS6; PRS7; PRS9; PRS10; PRS11; PRS15; PRS17; PRS19; QRSS; PRB20; PRS20; PRS23; PRS29; PRS31; DW, OCT, 1, 2, 3, 4, "1 - 0";	yes	RX pattern Examples: :RX:PTN$_U$DW,1,"1001101"; Length of digital word: 1 to 32 bits :RX:PTN$_U$OCT,"10011100"; Length of octet: 8 bits Digital words 1 to 4 Octet DW number Bit pattern for DW and OCT
:RX:PRS U	NORM; INV; NORM;	yes	Inversion of RX pattern

RX settings (continued)

Program word	Parameter/Altered in software version:	Query	Explanation
:RX:CODE U	CMI_CCITT; AMI_1_2; HDB3; B3ZS; NRZ; RZ; NRZ_ECL; RZ_ECL; CMI; CMI_CCITT; CMI_ECL; CMI_I; CMI_I_CCITT; CMI_I_ECL; HDB3_120; NRZ_OPT; CMI_OPT; CMI_I_OPT;	yes	RX signal code 2048 kbit/s only: 3 V fixed amplitude; with optical interface option and bit rate >20 Mbit/s
:RX:EVAL U	NORM; NORM; ZB_N4; ZB_N_3; NORM_N4; NORM_N_3; ZB_N3; ZB_N_2; NORM_N3 NORM_N_2; INV0; NORM_INV0;	yes	Code error evaluation for codes: HDB3 HDB3 HDB3 HDB3 B3ZS B3ZS B3ZS B3ZS CMI CMI
:RX:DECOD U	NORM; NORM; MODIF;	yes	Decoding method for codes: HDB3, B3ZS and CMI
:RX:THLD U	50; AUTO; 30; 40; 50; 60; 70;	yes	Sampling threshold of RX signal in %
:RX:ERR_OUT U	CNTR1; CNTR1; CNTR2; CNTR3; CLK_TRB;	yes	Event trigger to skt [48] Tributary bit rate with frame option

RX settings

Program word	Parameter/Altered in software version:	Query	Explanation
:RX:ERR_INP U	TTL; ECL; TTL;	yes	Input sensitivity of external error input [49]
:RX:EQ U	OFF; 34MB; 139MB; OFF;	yes	Digital signal input equalizer 34 Mbit/s equalizer 139 Mbit/s equalizer
:RX:NOM_AMPL U	500;	yes	Nominal signal input amplitude: 50 mV to 4000 mV
:RX:LEVEL U	CCITT; CCITT; PMP;	yes	Input signal level Distribution point Protected monitor point
:RX:AUTO_LEV;		no	Automatic input sensitivity setting
:THLD:MI U	1000;	yes	Micro-interrupt threshold: 1µs to 13000 µs
:THLD:NO_SIG U	10;	yes	NO SIGNAL detection threshold (1 to 15 x micro-interrupt threshold): 1 to 15

Test channel assignment

Program word	Parameter/Altered in software version:	Query	Explanation
:CNTR:C1 U	BIT; BIT; CODE; CRCB; DLY; SLIP; OHC_M; OHC_UM; OFF;	yes	Counter 1 With PCM 30 CRC frame option only Overhead byte comparison:[1] Number of identical bytes Number of non-identical bytes
:CNTR:C2 U	CODE; BIT; CODE; CRCW; EXT; STFR; OFF;	yes	Counter 2 With PCM 30 CRC only Via socket [49] For PCM 1920, 480, 120 only (not for: FRM:SYST:TX_UUNFRM_2M,34M;)

Test channel assignment (continued)

Program word	Parameter/Altered in software version:	Query	Explanation
:CNTR:C3 U	BLC;	yes	Counter 3
	BIT;		
	BLC;		
	CODE;		
	FASW;		over one DEMUX hierarchy only
	FASB;		over one DEMUX hierarchy only
	EBIT;		PCM 30,PCM 30 CRC
	OFF;		
	FW_ALL;		all FASW, only possible over more than one DEMUX hierarchy
	FB_ALL;		all FASB, only possible over more than one DEMUX hierarchy
	2M_ALL;		all 2M events (FASW, CRC, EBIT)

1)Byte selection and comparison mask setting with: OHC:R_C_MASK 1,1M"1XXX0001"; (see figure 4-23)

Preset settings

Program word	Parameter/Altered in software version:	Query	Explanation
:PRESET U	139264; 3.x	no	PRESET setting: unframed mode Must not be used for new programs

TX/RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRAME U	OFF;	yes	Frame structure on/off
	OFF; 3.x **ON;**		Use only in connection with frame systems as per software version 2.x Must not be used for new programs

TX/RX frame setting (Option) (continued)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:SYST ␣	PCM1920; 3.x	yes	Frame system Must not be used for new programs PDH frames:
	PCM1920; 3.x		Compatible with :FRM_SYST:TX␣UNFRM_34M,140M; :FRM_SYST:RX␣140M,UNFRM_34M;
	PCM480; 3.x		Compatible with :FRM_SYST:TX␣UNFRM_8M,34M; :FRM_SYST:RX␣34M,UNFRM_8M;
	PCM120; 3.x		Compatible with :FRM_SYST:TX␣UNFRM_2M,8M; :FRM_SYST:RX␣8M,UNFRM_2M;
	PCM30CRC; 3.x		Compatible with :FRM_SYST:TX␣64K,2M; :FRM_SYST:RX␣2M,64K;
	PCM30; 3.x		Compatible with :FRM_SYST:TX␣64K,2M; :FRM_SYST:RX␣2M,64K; :FRM:TYPE:TX_PDH2M␣PCM30; :FRM:TYPE:RX_PDH2M␣PCM30;
	2M_34M; 3.x		Compatible with :FRM_SYST:TX␣UNFRM_2M,34M; :FRM_SYST:RX␣34M,UNFRM_2M;
			SDH frames:
	STM1_VC4; 2.x		Compatible with :FRM:SYST ␣STM1_C4;
	3.x		Compatible with :FRM_SYST:TX␣UNFRM_140M,STM1_C4; :FRM_SYST:RX␣STM1_C4,UNFRM_140M;
			SDH frames:
	STM1_C4; 3.x		C-4 Compatible with :FRM_SYST:TX␣UNFRM_140M,STM1_C4; :FRM_SYST:RX␣STM1_C4,UNFRM_140M;
	STM1_C12; 3.x		C-12 Compatible with :FRM_SYST:TX␣UNFRM_2M,STM1_C12; :FRM_SYST:RX␣STM1_C12,UNFRM_2M

TX/RX frame setting (Option) (continued)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM_SYST:TX U	UNFRM_140M,FRM_OFF;	yes	TX frame setting Signal insertion, extraction
Parameter 1 (Signal coupling)	FRM_PATT_140M, FRM_PATT_34M, FRM_PATT_8M, FRM_PATT_2M,		
	UNFRM_155M,		Only possible with *Parameter 2* = FRM_OFF; Examples:
	UNFRM_140M, UNFRM_34M, UNFRM_8M, UNFRM_2M, 64K, EXT_2M,		:FRM_SYST:TX$_U$UNFRM_2M,STM1_C12; (= Frame system STM-1 C-12) :FRM_SYST:TX$_U$UNFRM_8M,PDH_34M; (= Frame system PCM 480) :FRM_SYST:TX$_U$64K,PDH_2M; (=Frame system PCM 3O CRC)
Parameter 2 (Signal extraction)	STM1_C12;		Only possible if *Parameter 1*: 64K, FRM_PATT_2M, UNFRM_2M or EXT_2M
	STM1_C4;		For all parameters listed under *Parameter 1*
	STM1_C3;		Not possible if *Parameter 1*: FRM_PATT_140M or UNFRM_140M
	PDH_140M;		Not possible if *Parameter 1*: UNFRM_140M
	PDH_34M;		Only possible if *Parameter 1*: 64K, FRM_PATT_2M, FRM_PATT_8M, FRM_PATT_34M, UNFRM_2M, UNFRM_8M or EXT_2M
	PDH_8M;		Only possible if *Parameter 1*: 64K, FRM_PATT_2M, FRM_PATT_8M, UNFRM_2M or EXT_2M
	PDH_2M;		Only possible if *Parameter 1*: 64K or FRM_PATT_2M
	FRM_OFF;		Must be used as 2nd parameter if output signal is to be unframed. Only possible if *Parameter 1* = UNFRM_XX XX = 155M, 140M, 34M, 8M, or 2M

TX/RX frame setting (Option) (continued)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM_SYST:RX $_U$	FRM_OFF,UNFRM_140M;	yes	RX frame setting, Signal insertion, extraction
Parameter 1 (Signal insertion)	STM1_C12,		Only possible if *Parameter 2*: 64K, FRM_PATT_2M or UNFRM_2M
	STM1_C4,		Possible for all parameters listed under *Parameter 2*
	STM1_C3,		Not possible if *Parameter 2*: FRM_PATT_140M or UNFRM_140M
	PDH_140M,		Not possible if *Parameter 2*: UNFRM_140M
	PDH_34M,		Only possible if *Parameter 2*: 64K, FRM_PATT_2M, FRM_PATT_8M FRM_PATT_34M, UNFRM_2M, or UNFRM_8M
	PDH_8M,		Only possible if *Parameter 2*: 64K, FRM_PATT_2M, FRM_PATT_8M or UNFRM_2M
	PDH_2M,		Only possible if *Parameter 2*: 64K or FRM_PATT_2M
	FRM_OFF,		Must be used as 1st parameter if output signal is to be unframed. Only possible if *Parameter 2* = UNFRM_XX XX = 155M, 140M, 34M, 8M, or 2M
Parameter 2 *(Signal* *extraction)*	FRM_PATT_140M; FRM_PATT_34M; FRM_PATT_8M; FRM_PATT_2M; UNFRM_155M;		Only possible if *Parameter 1* = FRM_OFF,
	UNFRM_140M; UNFRM_34M; UNFRM_8M; UNFRM_2M; 64K;		Examples: :FRM_SYST:RX$_U$STM1_C12,UNFRM_2M; (= Frame system STM-1 C-12) :FRM_SYST:RX$_U$PDH_34M,UNFRM_8M; (= Frame system PCM 480) :FRM_SYST:RX$_U$PDH_2M,64K; (=Frame system PCM 3O CRC)

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:TYPE:TX_PDH2M U	PCM30CRC;	yes	Transmitter: PCM 30/31: CRC on/off
	PCM30CRC; PCM30; PCM31CRC; PCM31;		PCM 30 CRC PCM 30 PCM31CRC PCM31
:FRM:TYPE:RX_PDH2M U	PCM30CRC;	yes	Receiver: PCM 30/31: CRC on/off
	PCM30CRC; PCM30; PCM31CRC; PCM31;		PCM 30 CRC PCM 30 PCM31CRC PCM31
:FRM:CONF U	EXC;	yes	D.U.T. and frame configuration
	3.x		Must not be used in new programs.
	DMX; 3.x **EXC;** **MUX;**		Only possible in connection with frame systems as per software version 2.x
:FRM:AIS U	OFF;	yes	Frames with AIS on / off not for STM-1
	OFF; 3.x		Compatible with highest hierarchy level present (see under :FRM:AIS$_U$ON;)
	ON; 3.x		:FRM:AIS Compatible with (depending on set bit rate): :FRM:AIS_2M :FRM:AIS_8M :FRM:AIS_34M :FRM:AIS_140M
:FRM:AIS_2M U	OFF;	yes	2 Mbit/s frame with AIS on/off
	OFF; ON;		
:FRM:AIS_8M U	OFF;	yes	8 Mbit/s frame with AIS on/off
	OFF; ON;		
:FRM:AIS_34M U	OFF;	yes	34 Mbit/s frame with AIS on/off
	OFF; ON;		
:FRM:AIS_140M U	OFF;	yes	140 Mbit/s frame with AIS on/off
	OFF; ON;		

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:DNYY U	"0111";	yes	DNYY alarm bits for PCM 1920
:FRM:AN U	"01";	yes	AN alarm bits for PCM 480, PCM 120 and 2M_34M
	3.x		Compatible with (depending on set bit rate): :FRM:DN_PDH8M$_U$<>; :FRM:DN_PDH34M$_U$<>;
:FRM:DN_PDH8M U	"01";	yes	DN alarm bits for PCM 120
:FRM:DN_PDH34M U	"01";	yes	DN alarm bits for PCM 480
:FRM:TX:NFAS U	"011111";	yes	Bits 3 to 8 of NFAS for PCM 30, PCM 30 CRC
:FRM:TX:SA_POS U	OFF;	yes	S_a bit position in NFAS
Parameter 1	*Position*; OFF;		Any entry: 4 to 8 Examples: :FRM:TX:SA_POS$_U$4; :FRM:TX:SA_POS$_U$OFF;
:FRM:RX:SA_POS U	OFF;	yes	S_a bit evaluation
Parameter 1	*Position*; OFF;		Any entry: 4 to 8
:FRM:TX:SA_PTN U	"00000000";	yes	Pattern for selected S_a bits
:FRM:TS16_PTN0 U	"00001011";	yes	Pattern in TS 16 of frame 0
:FRM:TS16_PTN1 U	"11011101"	yes	Pattern in TS 16 of frame 1
:FRM:TS16_PTN2 U	"11011101"	yes	Pattern in TS 16 of frames 2 to 15
:FRM:CH:FREE U	PRS6;	yes	Stuffing signal for non-selected tributaries, also for STM-1 C-12
	PRS6; TX_PTN;		
	ONE;		Not for PCM 30, PCM 30 CRC
	3.x		No longer available
	ZERO;		Not for PCM 30, PCM 30 CRC
	3.x		No longer available
Parameter 1	OCT,		For PCM 30, PCM 30 CRC only
Parameter 2	"11010101";	no	Bit pattern for OCT only Example: :FRM:CH:FREE$_U$OCT, "11100010"; Length of octet: 8 bits
:FRM:FREE:NFAS U	"0111111";	yes	NFAS in idle channels

TX / RX frame setting (Option)

Program word		Parameter/Altered in software version:	Query	Explanation
:FRM:FREE:CRC	U	OFF; ON; OFF;	yes	PCM 30 with/without CRC in idle channels PCM 30 CRC PCM 30
:FRM:FREE:AIS_2M	U	OFF; ON; OFF;	yes	AIS insertion in all idle channels of the 2 Mbit/s level
:FRM:FREE:AIS_8M	U	OFF; ON; OFF;	yes	AIS insertion in all idle channels of the 8 Mbit/s level
:FRM:FREE:AIS_34	U	OFF; ON; OFF;	yes	AIS insertion in all idle channels of the 34 Mbit/s level
:FRM:FREE:DN	U	"01";	yes	DN bits in all idle channels of the 8 and 34 Mbit/s levels
:FRM:CH:TX	U	1; 3.x	yes	Tributary (TX channel) Ranges: 1 for STM1- C-4 1 to 4 for PCM 1920, PCM 480, PCM 120 1 to 31 for PCM 30, PCM 30 CRC 1 to 16 for 2M_34M 1 to 63 for STM-1 C-12 Must not be used for new programs. Compatible with: :FRM:CH:TX_PDH2M :FRM:CH:TX_PDH8M :FRM:CH:TX_PDH34M :FRM:CH:TX_PDH140M :FRM:CH:TX_STM1C12 :FRM:CH:TX_STM1C3

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:CH:RX U	1;	yes	Tributary (RX channel) Ranges: 1 for STM-1 C-4 1 to 4 for PCM 1920, PCM 480, PCM 120 1 to 31 for PCM 30, PCM 30 CRC 1 to 16 for 2M_34M 1 to 63 for STM-1 C-12
	3.x		Must not be used for new programs. Compatible with: :FRM:CH:RX_PDH2M :FRM:CH:RX_PDH8M :FRM:CH:RX_PDH34M :FRM:CH:RX_PDH140M :FRM:CH:RX_STM1C12 :FRM:CH:RX_STM1C3
:FRM:CH:TX_PDH2M U	1;	yes	Tributary (TX channel) Range: 1 to 31
:FRM:CH:TX_PDH8M U	1;	yes	Tributary (TX channel) Range: 1 to 4
:FRM:CH:TX_PDH34M U	1;	yes	Tributary (TX channel) Range: 1 to 4
:FRM:CH:TX_PDH140M U	1;	yes	Tributary (TX channel) Range: 1 to 4
:FRM:CH:TX_STM1C12 U	1;	yes	Tributary (TX channel) Range: 1 to 63
:FRM:CH:TX_STM1C3 U	1;	yes	Tributary (TX channel) Range: 1 to 3
:FRM:CH:RX_PDH2M U	1;	yes	Tributary (RX channel) Range: 1 to 31
:FRM:CH:RX_PDH8M U	1;	yes	Tributary (RX channel) Range: 1 to 4
:FRM:CH:RX_PDH34M U	1;	yes	Tributary (RX channel) Range: 1 to 4
:FRM:CH:RX_PDH140M U	1;	yes	Tributary (RX channel) Range: 1 to 4
:FRM:CH:RX_STM1C12 U	1;	yes	Tributary (RX channel) Range: 1 to 63
:FRM:CH:RX_STM1C3 U	1;	yes	Tributary (RX channel) Range: 1 to 3
:FRM:TX:C12_MAP U	ASYNC; ASYNC; BITSYNC;	yes	Mapping for STM-1 C-12 TX only (RX fixed at ASYNC)

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:SCR:TX U	ON;	yes	STM-1: TX scrambler
	ON;		
	OFF;		
	7BIT; 2.x		Compatible with ON
	11BIT; 2.x		No longer available
:FRM:SCR:RX U	ON;	yes	STM-1: RX scrambler
	ON;		
	OFF;		
	7BIT; 2.x		Compatible with ON
	11BIT; 2.x		No longer available
:FRM:ALM U	OFF;	yes	STM-1 TX alarms
	OFF;		
	PAIS; 2.x		Compatible with AU_AIS
	SAIS; 2.x		Must be replaced with MS_AIS
	FERF; 2.x		Compatible with MS_FERF
	MS_AIS;		C-4, C-12, C-3
	AU_AIS;		C-4, C-12, C-3
	TU_AIS;		C-4, C-12, C-3
	MS_FERF;		C-4, C-12, C-3
	HP_FERF;		C-4, C-12, C-3
	LP_FERF;		C-12, C-3
	HP_UNEQ;		C-4, C-12, C-3
	LP_UNEQ;		C-12, C-3
	AU_LOP;		C-4, C-12, C-3
	TU_LOP;		C-12, C-3
	LOF;		Loss of Frame
	LOS;		Loss of Signal
	LOM;		C-12 only, loss of multiframe
:FRM:ALM_GEN U	STAT;	yes	Alarm generation
Parameter 1	STAT;		Static
	FRM,		in terms of frames
	TIME,		in terms of time
Parameter 2	*M;*		Any entry for number of frames for FRM: M = 1 to 500
	T;		Any entry for time: T x 100 msec for TIME: T = 1 to 98 (0.1 to 9.8 s)
			Examples: :FRM:ALM_GEN$_U$STAT; :FRM:ALM_GEN$_U$FRM,9; :FRM:ALM_GEN$_U$TIME,1;

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:ALM_CYCLE U	1;	yes	Alarm cycle (n x 100 msec) Any entry: 1 to 99 (0.1 to 9.9 sec) (n > T; see :FRM:ALM_GEN)
:FRM:TRIB_OFFS U	0;	yes	Tributary offset Any entry in ppm (step width 5 ppm): 0 to ± 50 for C-4 0 to ± 100 for C-12 asynchronous 0 to ± 30 for C-12 synchronous 0 to ± 60 for C-3
:FRM:VC12_POH U	"00001";	yes	VC12-POH V5 bits 4 to 8 Enter 0 or 1 (length 5 bits)
:FRM:OUT:RX U	FRM_TRIG;	yes	STM-1 output socket [54]
	TRG; 2.x		Parameter compatible with FRM_TRIG
	FRM_TRIG; MFRM_TRIG;		Frame trigger Multiframe trigger (for C-12 only)
	S_LOSS;		Sync. loss
:FRM:TRG:TX U	FRM_TRIG;	yes	STM-1TX frame trigger [52]
	EXT; 2.x		Parameter compatible with FRM_SYNC
	INT; 2.x		Parameter compatible with FRM_TRIG
			Socket [52] = output for:
	FRM_TRIG; MFRM_TRIG;		Frame trigger Multiframe trigger (for C-12 only)
	8KHZ_TRIG;		8 kHz trigger Socket [52] = input for:
	FRM_SYNC; MFRM_SYNC;		Frame synchronization Multiframe synchronization (for C-12 only)
:FRM:AUTO_TRIB U	OFF;	yes	Automatic channel scan (for C-12 only)
	OFF; SCAN; SEARCH		
:FRM:DELAY U	1.0;		Delay time in seconds for result request in SEARCH and SCAN modes
	Delay time;		Value range: 0.0 to 99.9 s in steps of 0.1 s

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:PTR_EVAL U	OFF; OFF; ON;	yes	Activation of pointer evaluation in SDH modes
:FRM:V11:TX U	OFF; **SOH81;** 2.x **SOH58;** 2.x **POH9;** 2.x **POH6;** 2.x **OFF;** 2.x	yes	STM-1: Read in: SOH (81 Bytes) Must be replaced with: :FRM_OH:R_C:TX <>; SOH (58 Bytes) Must be replaced with: :FRM_OH:R_C:TX <>; POH (9 Bytes) Must be replaced with: :FRM_OH:R_C:TX <>; POH (6 Bytes) Must be replaced with: :FRM_OH:R_C:TX <>; No longer available in SOH / POH via skt. [53] V.11 Input

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM:V11:RX $_U$	OFF;	yes	STM-1:Read out:
	SOH; 2.x		SOH (5.184 Mbit) Compatible with :FRM_OH:R_C:RX$_U$V11_SOH;
	POH; 2.x		POH (567 kbit) Compatible with :FRM_OH:R_C:RX$_U$V11_POH;
	D1_3; 2.x		D1 to D3 (192 kbit) Compatible with :FRM_OH:R_C:RX$_U$V11_D1_3;
	D4_12; 2.x		D4 to D12 (576 kbit) Compatible with :FRM_OH:R_C:RX$_U$V11_D4_12;
	E1; 2.x		E1 (64 kbit) Compatible with :FRM_OH:R_C:RX$_U$r,c,V11;
	E2; 2.x		E2 (64 kbit) Compatible with :FRM_OH:R_C:RX$_U$r,c,V11;
	F1; 2.x		F1 (64 kbit) Compatible with :FRM_OH:R_C:RX$_U$r,c,V11;
	OFF; 2.X		Compatible with :FRM_OH:R_C:RX$_U$OFF; from SOH / POH via skt. [53] V.11 Output

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM_OH:R_C:TX U	1,7,"AA";	no	Overhead generation
Parameter 1	DEFAULT;		Default setting of SOH/POH Example: :FRM_OH:R_C:TX$_U$DEFAULT;
Parameter 1 *Parameter 2*	*Row,* *Column,*		Any entry: Row = 1 to 9 column = 1 to 10 (10 = POH) C-3 = 1 to 11 (11 = VC3_POH)
Parameter 3	"AA";		static content in hex code (1 byte)
	PATT; PATT_GRP;		Filled with TX pattern Group filled with TX pattern 64 byte sequence
	SEQ; V11; V11_GRP;		Filled via V.11 [53] Group filled via V.11 [53] Examples: :FRM_OH:R_C:TX$_U$1,8,"FF"; :FRM_OH:R_C:TX$_U$3,9,PATT; :FRM_OH:R_C:TX$_U$4,9,V11_GRP ;
:FRM_OH:SEQ_HEX U	1,"FF";	no	64 byte sequence in hex code
Parameter 1	*Position,*		Any entry for byte position: 1 to 64
Parameter 2	*"Hex value";*		Hex value for byte: 0 to FF Example: :FRM_OH:SEQ_HEX$_U$1,"0A";
:FRM_OH:SEQ_ASC U	1,"A";	no	64 byte sequence in ASCII
Parameter 1	*Position,*		Any entry for byte position: 1 to 64
Parameter 2	*"Characters";*		ASCII characters (refer to manual operation) Example: :FRM_OH:SEQ_ASC$_U$1,"A";
:FRM_OH:SEQ_PATH$_U$	1,"A";	no	15byte trace path in ASCII
Parameter 1	*Position,*		Any entry for byte position: 1 to 15
Parameter 2	*"Characters";*		ASCII-Zeichen (refer to manual operation) Example: FRM_OH:SEQ_PATH$_U$1,"A";

TX / RX frame setting (Option)

Program word	Parameter/Altered in software version:	Query	Explanation
:FRM_OH:R_C:RX U	OFF;	yes	Overhead output
	OFF;		No output
			Output via V.11 [55]:
	V11_SOH;		SOH
	V11_POH; 4.x		VC4-POH compatibel with: V11_C4_POH;
	V11_C4_POH;		VC4-POH
	V11_C3_POH;		VC3-POH
	V11_D1_3;		D1 to D3
	V11_D4_12;		D4 to D12
	V11_K1_2;		K1, K2
	V11_3Z1;		3 x Z1
	V11_3Z2;		3 x Z2
	V11_Z3_5; 4.x		Z3 to Z5 compatible with: V11_C4_Z3_5;
	V11_C4_Z3_5;		Z3 to Z5 of VC4 POH
	V11_C3_Z3_5;		Z3 to Z5 of VC3 POH
			Evaluation:
	EVAL_D1_3;		D1 to D3
	EVAL_D4_12;		D4 to D12
	EVAL_K1_2;		K1, K2
	EVAL_3Z1;		3 x Z1
	EVAL_3Z2;		3 x Z2
	EVAL_Z3_5; 4.x		Z3 to Z5 compatible with: EVAL_C4_Z3_5;
	EVAL_C4_Z3_5;		Z3 to Z5 of VC4 POH
	EVAL_C3_Z3_5;		Z3 to Z5 of VC3 POH
			Any entry:
Parameter 1	*Row,*		Row = 1 to 9
Parameter 2	*Column,*		Column = 1 to 10 (10 = POH) C-3 = 1 to 11 (11 = VC3_POH) Output via V.11 [55]
Parameter 3	V11; EVAL;		Counter evaluation Examples: :FRM_OH:R_C:RX$_U$V11_SOH; :FRM_OH:R_C:RX$_U$EVAL_K1_2; :FRM_OH:R_C:RX$_U$1,8,EVAL;

Gate settings

Program word	Parameter	Query	Explanation
:START;		no	Start measurement
:STOP;		no	Stop measurement
:ST_EVENT U	MAN; MAN; TIMER;	yes	Start event Manual or using timer
:ST_DATE U	"1.01"; "*dd.mm*";	yes	Date for timer start dd: 1to 31 mm: 1 to 12
:ST_TIME U	"0.00"; "*hh.mm*";	yes	Time for timer start hh: 0 to 23 mm: 0 to 59
:GATE:CYCLE U *Parameter 1* *Parameter 2*	SINGLE; SINGLE; REP, *Number;*	yes	Measurement cycle Repetitive Number of measurement cycles: 1 to 99 Example For one measurement: :GATE:CYCLE$_U$SINGLE; For 3 measurements: :GATE:CYCLE$_U$REP,3; For REP = infinity: :GATE:CYCLE$_U$REP;
:GATE:INTV:TIME U *Parameter 1* *Parameter 2*	MS,"1.00"; DH, HM, MS, SS, "*dd.hh*"; "*hh.mm*"; "*mm.ss*"; "*ss.s*";	yes	Measurement interval in terms of time Examples: :GATE:INTV:TIME$_U$MS,"3.00" :GATE:INTV:TIME$_U$SS,"50.5" Any entry: dd: 0 to 99 days DH hh: 0 to 23 hours hh: 0 to 99 hours HM mm: 0 to 59 minutes mm: 0 to 99 minutes MS ss: 0 to 59 seconds ss: 0 to 99 seconds SS s: 0 to 9

Date and time setting

Program word	Parameter	Query	Explanation
:DATE U	"01.01.90"; *"dd.mm.yy"*;	yes	ACurrent date dd: 1 to 31 (day) mm: 1 to 12 (month) yy: 0 to 99 (year) *Note:* Range of years enterable is 1992 to 2045.
:TIME U	"00.00.00"; *"hh.mm.ss"*;	yes	Current time hh: 0 to 23 mm: 0 to 59 ss: 0 to 59

Beeper

Program word	Parameter	Query	Explanation
:BEEP U	WARN; EVENT; WARN; OFF;	yes	Beeper On for warnings and events On for warnings Off

Panel lock

Program word	Parameter	Query	Explanation
:PANEL U	UNLOCK; LOCK; UNLOCK;	yes	Disable / enable front panel controls Controls disabled Controls enabled

Menüsprache

Program word	Parameter	Query	Explanation
:LANGUA U	ENG; ENG; GER; SPA;	yes	Select menu language (out of two possibilities) English (available in every instrument) Deutsch (additionally available in German version) Spanisch (additionally available in Spanish version)

Display

Program word	Parameter/Altered in software version:	Query	Explanation
:DISP:RESULT U	S_A;	no	Select result display on screen:
	S_A;		Left-hand side: Standard Right-hand side: Stored Alarms
	2.x		Must be replaced with: :DISP:MENU:NAME$_U$<>;
	S_B;		Left-hand side: Standard Right-hand side: All Results
	2.x		Must be replaced with: :DISP:MENU:NAME$_U$<>;
:DISP:MENU:NAME U	CNTR,TX_RX;	yes	Select menu display on screen:
Parameter 1 *(left-hand side)*	CNTR, G821, PARITY, ALL, SOH_POH, SEQU,		left-hand side: Counters 1-3 G.821 results For STM-1also: Parity/pointers All results except G.821 SOH/POH graph 64 bytes in hex and ASCII codes
Parameter 2 *(right-hand side)*	TX_RX; ALL; ALARM; G821;		right-hand side: TX and RX parameters All results except G.821 Stored alarms G.821 results
:DISP:ENAB U	ON;	yes	Display on/off When OFF is set, the message "DISPLAY DISABLED" is displayed
	OFF; ON;		

Performance measurements

Program word	Parameter/Altered in software version	Query	Explanation
:PERFM:ANALYSIS U	OFF;	yes	Selection of different performance measurements
	OFF; G821; G826;		 Evaluation to ITU-T G.821 Evaluation to ITU-T G.826

G.821 evaluation

Program word	Parameter/Altered in software version:	Query	Explanation
:G821:VERSION U	BLUE;		Select G.821 version
	BLUE; RED;		Blue book version Red book version
:G821:PERFM U	BIT;	yes	G.821 evaluation for the events counted by
	BIT; CODE; **OFF**; 4.x		counters 1, 2, 3 compatible with: :PERFM:ANALYSIS$_U$OFF;
	BCRC;		With frame option only: PCM 30 CRC
	EBIT;		PCM 30, PCM 30 CRC
	FASB; 3.x		Compatible with:
	FASB_2M; FASB_8M; FASB_34M; FASB_140M; FASB_STM1;		FASB_2M; FASB_8M; FASB_34M; FASB_140M; FASB_STM1;
	FASW; 3.x		Compatible with:
	FASW_2M; FASW_8M; FASW_34M; FASW_140M; FASW_STM1;		FASW_2M; FASW_8M; FASW_34M; FASW_140M; FASW_STM1;
	B1; B2; B3;		STM-1
	FEBE; 2.x		Compatible with HP_FEBE
	HP_FEBE; LP_FEBE; LP_BIP; LP_B3;		C-4, C-12, C-3 C-12, C-3 C-12 only C-3 only
:G821:MXDIV U	ON;	yes	G.821 MUX divider on / off
	OFF; ON;		
:G821:THLD:INIT;		no	G.821 threshold for SES and DM to ITU-T SES = 1E-3 DM = 1E-6

G.821 evaluation

Program word	Parameter/Altered in software version:	Query	Explanation
:G821:THLD:SES U	1E-3;	yes	G.821 threshold for SES Any entry: nE-m n = 1 to 9 m = 2 to 5
:G821:THLD:DM U	1E-6;	yes	G.821 threshold for DM Any entry: nE-m n = 1 to 9 m = 2 to 7
:G821:AS_ES U	ON; OFF; ON;	yes	Alarm seconds = SES evaluation on / off
:G821:PRT:INTV1 U	OFF; OFF; ON;	yes	1st intermediate print interval on / off (minutes)
:G821:PRT:INTV2 U	OFF; OFF; ON;	yes	2nd intermediate print interval on / off (hours)
:G821:PRT:INTV3 U	OFF; OFF; ON;	yes	3rd print intermediate print interval on / off (days)
:G821:PRT:INT1 U	15MIN; 5MIN; 10MIN; 15MIN; 30MIN;	yes	1st intermediate print interval time
:G821:PRT:INT2 U	1H; 1H; 2H; 4H; 8H;	yes	2nd intermediate print interval time

G.826 evaluation

Program word	Parameter/Altered in software version	Query	Explanation
:G826:LIM:MODE U	OFF; OFF; DEFAULT; USR_ALLOC; USR_S1_S2;		Selection of G.826 limit values mode settings Default = 18.5% of the reference path is used as basis for the evaluation User allocated path proportion, 18.5% (default) modifiable using :G826:ALLOC$_U$<>; User-defined S1 and S2 thresholds
:G826:ALLOC U	185; *Path proportion;*		Enter the path size as a proportion of the reference path in %. Value range: 0.1 to 100% in steps of 0.1% Example: :G826:ALLOC$_U$185; corresponds to a path proportion of 18.5%. *Note*: Only activated for :G826:LIM:MODE$_U$USR_ALLOC;
:G826:LIM:S1:ES U	107; *S1 threshold for ES;*		Input of S1 threshold for ES Value range: 0 to 9999999 *Note*: Only activated for :G826:LIM:MODE$_U$USR_S1_S2;
:G826:LIM:S1:SES U	1; *S1 threshold for SES;*		Input of S1 threshold for SES Value range: 0 to 99999 *Note*: Only activated for :G826:LIM:MODE$_U$USR_S1_S2;
:G826:LIM:S1:BBE U	1066; *S1 threshold for BBE;*		Input of S1 threshold for BBE Value range: 0 to 999999999 *Note*: Only activated for :G826:LIM:MODE$_U$USR_S1_S2;

G.826 evaluation

Program word	Parameter/Altered in software version	Query	Explanation
:G826:LIM:S2:ES U	107; *S2 threshold for ES;*		Input of S2 threshold for ES Value range: 0 to 9999999 *Note*: Only activated for :G826:LIM:MODE$_U$USR_S1_S2;
:G826:LIM:S2:SES U	1; *S2 threshold for SES;*		Input of S2 threshold for SES Value range: 0 to 99999 *Note*: Only activated for :G826:LIM:MODE$_U$USR_S1_S2;
:G826:LIM:S2:BBE U	1066; *S2 threshold forBBE;*		Input of S2 threshold for BBE Value range: 0 to 999999999 *Note*: Only activated for :G826:LIM:MODE$_U$USR_S1_S2;
:G826:LIM:UAS:PROC U	OFF; OFF; ON;		UAS included in evaluation of the path
:G826:LIM:UAS:THLD U	0; *UAS- threshold;*		UAS threshold in % (if :G826:LIM:UAS:PROC$_U$ON;) Value range: 0.0 to 9.99999% in steps of 0.00001% Example: :G826:LIM:UAS:THLD$_U$1; corresponds to 0.00001%
:G826:EVALUATION U	NEAR_END; NEAR_END; FAR_END;		Selection of the path to be evaluated. Selection only available for SDH; PDH evaluation from near end (forward path) only Near end (forward path) Far end (backward path)
:G826:THLD:SES U	2400; *SES threshold;*		Input of threshold above which EB (errored blocks) are counted as SES. Value range: 1 to 10000

Note: G.826 evaluation:
The parameter values indicated in the first line of the "Parameter" column for each program word are the default values for an evaluation at the STM-1 C4 level.

Printer settings

Program word	Parameter/Altered in software version:	Query	Explanation
:PRT:USERLINE U	OFF; OFF; ON;	yes	User-defined text printed as header of printout. The text is defined using :PRT:USERL1 and :PRT:USERL2.
:PRT:USERL1 U	"TEXT1";	yes	Text for USERLINE 1 Any entry of up to 19 ASCII characters
:PRT:USERL2 U	"TEXT2";	yes	Text for USERLINE 2 Any entry of up to 19 ASCII characters
:PRT:TRIGG U	MAN; AUTO; MAN; THLD;	yes	Printer trigger selection Conditional printout
:PRT:DEV U	INT; INT; EXT_V24;	yes	Select printer (internal/external) as output device. Internal printer External printer connected to serial interface (socket [45])
:PRT:DRIVER U	HP_DESK; HP_DESK; HP_LASER; IBM_PRO; EPSON_LQ;	yes	Driver for external printer

Printer settings (continued)

Program word	Parameter/Altered in software version:	Query	Explanation
:PRT:MODE U	NORMAL;	yes	Printer operating mode
Parameter 1	NORMAL;		
	RC;		"Remote Command": The corresponding remote control command is printed out whenever a control element is operated.
	DIAGR,		Diagram (histogram) printout
Parameter 2 (only possible for Parameter 1 = DIAGR,)	BIT;		
	CODE;		
	BLC;		
	EXT;		
	CRCW;		With frame option only
	EBIT;		
	FASB; 3.x		Compatible with: FASB_2M; FASB_8M; FASB_34M; FASB_140M; FASB_STM1;
	FASB_2M;		
	FASB_8M;		
	FASB_34M;		
	FASB_140M;		
	FASB_STM1;		
	FASW; 3.x		Compatible with: FASW_2M; FASW_8M; FASW_34M; FASW_140M; FASW_STM1;
	FASW_2M;		
	FASW_8M;		
	FASW_34M;		
	FASW_140M;		
	FASW_STM1;		
			Examples:
	B1;		:PRT:MODE$_U$RC;
	B2;		:PRT:MODE$_U$DIAGR,P_PTR;
	B3;		
	P_PTR;		Positive pointers
	N_PTR;		Negative pointers
	PN_PTR;		Pointer total (pos. + neg. pointers)
	FEBE; 2.x		DIAGR,FEBE Compatible with DIAGR,HP_FEBE
	HP_FEBE;		C-4, C-12, C-3
	LP_FEBE;		C-12, C-3
	LP_BIP;		C-12 only
	LP_B3;		C-3 only

Printer settings

Program word	Parameter/Altered in software version:	Query	Explanation
:PRT:THLD:TYPE U	CNTR1;	yes	Select counter for conditional printout; applies to: PRT:TRIGG$_U$THLD;
	CNTR1;		Counter 1
	CNTR2;		Counter 2
	CNTR3;		Counter 3
	OFF;		
	FASB_2M;		
	FASB_8M;		
	FASB_34M;		
	FASB_140M;		
	FASB_STM1;		
	FASW_2M;		
	FASW_8M;		
	FASW_34M;		
	FASW_140M;		
	FASW_STM1;		
	B1;		With frame option only
	B2;		
	B3;		
	P_PTR;		Positive pointers
	N_PTR;		Negative pointers
	PN_PTR;		Pointer total (pos. + neg. pointesr)
	FEBE; 2.x		Compatible with HP_FEBE
	HP_FEBE;		C-4, C-12, C-3
	LP_FEBE;		C-12, C-3
	LP_BIP;		C-12 only
	LP_B3;		C-3 only
:PRT:THLD:COUNT U	10000;	yes	Error count threshold Any entry: 0 to 9.0E9
:PRT:THLD:INCR U	5000;	yes	Error increment threshold Any entry: 0 to 9.0E9
:PRT:THLD:RATIO U	1.0E-6;	yes	Error rate threshold Any entry: 1.0E-9 to 1.0E-1
:PRT:PRINT;		no	Print actual setting and results Corresponds to PRINT key
:PRT:STOP;		no	Stop printout Corresponds to STOP/PAPER key
:PRT:PANEL;		no	Print actual instrument settings Corresponds to softkey PRINT SETTINGS

Memory functions

Program word	Parameter/Altered in software version:	Query	Explanation
:MEM:RCL U	1;	no	Recall a stored device setting from internal setup memory: Any entry: 1 to 20
	2.x		Any entry: 1 to 10
			from the memory card (64 K): Any entry: 101 to 120 201 to 220
	2.x		Any entry: 101 to 110 201 to 210
:MEM:STO U	1;	no	Store the current device setting to internal setup memory: Any entry: 1 to 20
	2.x		Any entry: 1 to 10
			to the memory card (64 K): Any entry: 101 to 120 201 to 220
	2.x		Any entry: 101 to 110 201 to 210
:MEM:NAME U	1,"Setup name";	no	Edit a setup name
Parameter 1	*Setup no*,		Any entry: 1 to 20 101 to 120 201 to 220
	2.x		Any entry: 1 to 10 101 to 110 201 to 210
Parameter 2	*"Setup name"*;		Any entry of setup name: 1 to 8 ASCII characters
:MEM:PLIST U	1;	no	Print out of a stored device setting from internal setup memory: Any entry: 1 to 20
	2.x		Any entry: 1 to 10
			from the memory card (64 K): Any entry: 101 to 120 201 to 220
	2.x		Any entry: 101 to 110 201 to 210
	ALL;		Print all setups from internal setup memory Examples: :MEM:PLIST$_U$209; :MEM:PLIST$_U$ALL;

Memory functions

Program word	Parameter/Altered in software version:	Query	Explanation
:MEM:DEL U	1;	no	Delete a stored device setting from internal setup memory: Any entry: 1 to 20
	2.x		Any entry: 1 to 10
			from the memory card (64 k): Any entry: 101 to 120 201 to 220
	2.x		Any entry: 101 to 110 201 to 210
	ALL;		Delete all setups from internal setup memory
:RAMC:FORMAT;		no	Format memory card
:RAMC:PDIR;		no	Abbreviated print out of device settings stored on memory card
:RAMC:COPY U *Parameter 1* *Parameter 2*	101,102; *Source,* *Destination;*	no	Copy stored device setting Any entry for source and destination: Internal memory: 1 to 20 Memory card: 101 to 120 201 to 220
	2.x		Internal memory: 1 to 10 Memory card: 101 to 110 201 to 210
	ALL,		Examples: :RAMC:COPY$_U$ALL,101; copies the internal setup memory to the memory card (101 to 120; 101 to 110 from software version 2.x)
	ALL; 2.x		:RAMC:COPY$_U$201,ALL; copies the memory card (201 to 220: 201 to 210 from software version 2.x) to the internal memory 1 to 20 (1 to 10 from software version 2.x)
	2.x		:RAMC:COPY$_U$5,210; copies the internal setup no. 5 to the memory card position 210
:RAMC:DEL U *Parameter 1* *Parameter 2*	101,102; *Start,* *End;*	no	Delete stored device settings from the memory card Ranges for start and end: 101 to 120 201 to 220 101 to 110 201 to 210
	2.x		Examples: :RAMC:DEL$_U$101,110; deletes the segment 101 to 110 :RAMC:DEL$_U$205; deletes memory position 205

Result memory

Program word	Parameter/Altered in software version:	Query	Explanation
:RSLT:DISP U	INT;	no	Switch result display
	3.x		Command no longer available
	EXT;		Memory card result memory
	INT;		Internal result memory
	2.x		no longer available
:RSLT:CLEAR U	INT;	no	Delete result memory
	3.x		Command no longer available
	ALL;		All results
	EXT;		Results on memory card
	INT;		Internal results
	2.x		no longer available
:RSLT:INT_MEM U	LOCK;	no	Internal result memory
	3.x		Command no longer available
	LOCK;		Overwrite protected
	2.x		no longer available
	UNLOCK;		Overwrite enabled
	2.x		no longer available
:RSLT:EXT_MEM U	LOCK;	no	External result memory
	3.x		Command no longer available
	LOCK;		Overwrite protected
	UNLOCK;		Overwrite enabled
:RSLT:WORST U	BIT;	no	Recall worst-case error result (BIT, BLOCK etc.) longest or last alarm
	3.x		Command no longer available
	BIT;		
	BLOCK;		
	CODE;		
	EXT;		
	SLIP;		
	ALRM1;		longest alarm
	ALRM2;		last alarm
	CRCW;		Only available when appropriate
	EBIT;		frame option fitted
	FASB;		
	FASW;		
	B1;		
	B2;		
	B3;		
	P_PTR;		
	N_PTR;		
	PN_PTR;		
	HP_FEBE;		
	LP_FEBE;		
	LP_BIP;		
:RSLT:SCROLL U	NEXT;	no	Scroll through result numbers
	3.x		Command no longer available
	NEXT;		
	PREV;		

Result memory

Program word	Parameter/Altered in software version:	Query	Explanation
:RSLT:NR U	1; 3.x	no	Select actual result number Command no longer available
:RSLT:RECALL;	 3.x	no	Recall actual result number Command no longer available

Result monitor

Program word	Parameter/Altered in software version:	Query	Explanation
:CLR:STO_EV;	 3.x	no	Clear alarm memory Command no longer available
:PRT:STO_EV;		no	Print alarm memory

Transmit device setting recorded using *LRN?

Program word	Parameter/Altered in software version:	Query	Explanation
:LRN$_U$*Data field*		yes[1]	Transmits a data field recorded using *LRN?; (see "*LRN?;", section 4.3.3 "Common commands")

1)Query only possible via *LRN?;

Automatic measurements

Only the settings given below plus the commands "START" and "STOP" can be used. The data is output as a printout on the internal printer only, **not via the remote control interface**.

Autoconfiguration

Program word	Parameter/Altered in software version:	Query	Explanation
:AMA:CFG U	CCITT; CCITT; PMP;	yes	Start autoconfiguration Autoconfigure for distribution point Autoconfigure for protected monitoring point (PMP)

Sequence measurements

Program word	Parameter/Altered in software version:	Query	Explanation
:SEQ:SWITCH U	OFF; OFF; ON;	yes	Sequence switch
:SEQ:RNG U *Parameter 1* *Parameter 2*	1,10; *Start setup*, *Stop setup*; 2.x	yes	Sequence range Any entry for Start and stop setup: Internal setups: 1 to 20 Memory card (64 K): 101 to 120 201 to 220 Internal setups: 1 to 10 Memory card (64 K): 101 to 110 201 to 210 Examples: :SEQ:RNG$_U$1,7; Sequence range: 1 to 7 :SEQ:RNG$_U$1,205; Sequence range: 1 to 205
:SEQ:CYCLE U	SINGLE; REP; SINGLE;	yes	Sequence cycle

Function test program

Program word	Parameter/Altered in software version:	Query	Explanation
:AMA:FPP U	OFF; OFF; ON;	yes	Function test program for basic instrument and options
:FPP:TESTNR U	1;	yes	Start at test number
:FPP:FUNCTION U	ALL; ALL; SINGLE;	yes	Sequence control All test points Single test point
:FPP:CYCLE U	SINGLE; REP; SINGLE;	yes	Cycle control

Automatic tolerance to jitter measurement

Program word	Parameter/Altered in software version:	Query	Explanation
:J:AUTO U	OFF; OFF; MTJ;	yes	Tolerance to jitter measurement
:J:MTJ:THLD U	10;	yes	Error threshold 0 to 999
:J:MTJ:DELAY U	1.0;	yes	Measurement delay Any entry in seconds: 0.0 to 99.9
:J:MTJ:ERR_SRC U	CNTR2; CNTR2; HP_FEBE; LP_FEBE; HP_FERF; LP_FERF; B2; B3; LP_B3;	yes	MTJ error source Counter 2 C-4, C-12, C-3 C-12, C-3 C-4, C-12, C-3 C-12, C-3 C-4, C-12, C-3 C-4, C-12, C-3 C-3
:J:F_START U	0.002E3;	yes	Start frequency Any entry in Hz: 0.002E3 to 4500E3
:J:F_STOP U	4500E3;	yes	Stop frequency Any entry in Hz: 0.002E3 to 4500E3
:J:F_STEP U	5;	yes	Steps per decade 2 to 9
:J:F_SOURCE U	FIXED; FIXED; USER;	yes	Frequency values fixed as specified by :J:F_START, :J:F_STOP and :J:F_STEP As defined by user; up to 10 values; see :J:F_SELECT
:J:F_SELECT U *Parameter 1...10*	20,200,500, 1000,2000, 5000,10000, 40000,100000, 3500000; *Frequency 1*, *Frequency 2*, " " *Frequency 10*;	yes	Frequency values for :J:F_SOURCE$_U$USER; Any entry in Hz from 200 Hz to 4500000 Hz Example!: :J:F_SELECT$_U$200,2000,5000,...;

RS-232 settings

Program word		Parameter	Query	Explanation
:V24:PASSWD	U	"SF60";	yes	Set password (max. 19 characters)
:PASSWD	U	"SF60";	no	Password for modem operation (max. 19 characters)
:V24:DEV	U	MODEM; MODEM; PC; PRT;	yes	Operating mode External printer
:V24:BAUDR	U	2400; 300; 600; 1200; 2400; 4800; 9600;	yes	Baud rate
:V24:DATA	U	8; 7; 8;	yes	Number of data bits
:V24:PARITY	U	NO; EVEN; NO; ODD;	yes	Parity
:V24:STOP	U	1; 1; 2;	yes	Number of stop bits
:V24:HANDSH	U	HW; HW; SW;	yes	Handshake Hardware RTS / CTS Software XON / XOFF
:LOCK	U	ON; OFF; ON;	no	Simulation of GPIB command "LLO" (local lockout) LOCAL key enabled LOCAL key disabled
:REMOTE	U	ON; OFF; ON;	no	Simulate GPIB interface function "RL" (remote/local) Switch SF-60 to manual operation Switch SF-60 to remote operation

4.3.3 Common commands

The device behavior is based on
IEEE Standard Codes, Formats, ANSI/IEEE Std 488.2-1987

The common commands implemented for the SF-60 are given below in alphabetical order. The tables have the following meaning:

Command program

<PARAMETER> or <RESPONSE>	Command description
Example	Comments

*CLS **Clear Status Command**

*CLS;	Clears information stored in registers. Causes a partial remote-control initialization. The masks contained in the registers are not affected, see also 4.3.7.2 "GPIB initialization".

*DDT<param> **Define Device Trigger**

<ARBITRARY BLOCK PROGRAM DATA>	Description of trigger buffer. Buffer length 1000 bytes. If "#0" is used, the rest of the <PROGRAM MESSAGE> is stored in the buffer.
*DDT$_U$#0:PRESET$_U$2048;...; *DDT$_U$#3013:PRESET$_U$2048; Number of characters for storage in trigger buffer (here 13) Length of character string defining the number of characters in the buffer (here 3)	

*DDT? **Define Device Trigger Query**

<DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>	Reads ou the trigger buffer.
*DDT?; #40013:PRESET$_U$2048; Number of characters in trigger buffer (here 13, i.e. :PRESET$_U$2048;)) Length of character string defining the number of characters in the buffer (here 4)	

*ESE <param> Standard Event Status Enable Command

<DECIMAL NUMERIC PROGRAM DATA> in the range 0 to 255; *ESE$_U$32;	Sets the mask for the ESR register; see section 4.3.5.4 "Standard event status register ESR".

*ESE? Standard Event Status Enable Query

<NR1 NUMERIC RESPONSE DATA> in the range 0 to 255; *ESE?; 32;	Reads out the mask for the ESR register; see section 4.3.5.4 "Standard event status register ESR".

*ESR? Standard Event Status Register Query

<NR1 NUMERIC RESPONSE DATA> in the range 0 to 255; *ESR?; 32;	Reads out the ESR register; see section 4.3.5.4 "Standard event status register ESR"

*IDN? Identification Query

<ARBITRARY ASCII RESPONSE DATA> 4 fields separated by commas (,): <manufacturerer>,<device name>,<serial no.>, <firmware level>; *IDN?; WANDEL&GOLTERMANN,SF-60,B-0078,02.000;	Reads out the device identification data.

*IST? Individual Status Query

<NR1 NUMERIC RESPONSE DATA> in the range 0 to 1 *PRE$_U$1; *IST?; 1;	Reads out the device status ("ist" sum bit), formed from the mask set by *PRE and the contents of the status byte STB (see diagram, page 4-80). Enable alarm queue (AAV) in status byte register STB. "1": the alarm queue contains alarm data. "0": no data.

*LRN? Learn Device Setup Query

<ARBITRARY ASCII RESPONSE DATA> *LRN?; :LRN$_U$...;	Read out current device setting. The response has a length of approx. 1100 bytes. *Note:* Current device setups are not series-upwards compatible.

*OPC — Operation Complete Command

*OPC;	Sets the OPC bit in the standard event status register ESR as soon as the SF-60 assumes the idle state. Use is only sensible in conjunction with SRQ.

*OPC? — Operation Complete Query

<NR1 NUMERIC RESPONSE DATA> *OPC?; 1;	Output from SF-60 as soon as it assumes the idle state. As soon as all device settings have been made, "1" is written to the output buffer. Used for synchronizing device and user commands.

*OPT? — Option Identification Query

<ARBITRARY ASCII RESPONSE DATA> One or more fields separated by commas (,): <device BN>,<hardware option (frames)>, <hardware option (quad output)>, <software option>; 3017/01; 3017/02,3017/00.08,2074/00.10; SF-60 German — with frames option — with quad output	Reads out a list of the options fitted in the device. SF-60, English menu, no options SF-60, German menu, with frames option (e.g. PDH 34/140) and quad output.

*PCB <param> — Pass Control Back Command

<DECIMAL NUMERIC PROGRAM DATA> in the range 0 to 30 *PCB$_U$3,7;	Transfers the device address to which the SF-60 is to pass back active bus control. Passes back control function to device with primary address 3 and secondary address 7 (secondary address is optional).

*PRE <param> — Parallel Poll Enable Register Enable Command

<DECIMAL NUMERIC PROGRAM DATA> in the range 0 to 65535 *PRE$_U$64;	Sets the bit mask for the parallel poll enable register (PRE) for forming the "ist" sum bit; see diagram on page 4-80.

*PRE? — Parallel Poll Enable Register Enable Query

<NR1 NUMERIC RESPONSE DATA> in the range 0 to 65535 *PRE?; 64;	Reads out the bit mask for forming the "ist" sum bit; see diagram on page 4-80.

*PSC <param> Power-On Status Clear Command

<DECIMAL NUMERIC PROGRAM DATA> in the range 0 to 1 *PSC$_U$0;	Sets the device behavior following power on. In the example given, all remote control settings remain unchanged after power on.

*PSC? Power-On Status Clear Query

<NR1 NUMERIC RESPONSE DATA> *PSC?; 1; See section 4.3.7.1 "Power on behavior"	Queries the device behavior following power on. This response causes the SF-60 to assume the standard (default) settings following power on.

*RST Reset Command

*RST;	Device initialization. The SF-60 is placed in STOP status and presets the default values for 139264 Mbit/s. "*RST;" includes the initialization parameters executed by "*CLS;" (see section 4.3.7, "Initialization")

*SRE <param> Service Request Enable Command

<DECIMAL NUMERIC PROGRAM DATA> In the range 0 to 255 *SRE$_U$128;	Sets the SRQ mask.

*SRE? Service Request Enable Query

<NR1 NUMERIC RESPONSE DATA> *SRE?; 128;	Reads out the SRQ mask.

*STB? Read Status Byte Query

<NR1 NUMERIC RESPONSE DATA> *STB?; 128;	Reads out the status byte register.

*TRG Trigger Command

*TRG;	Executes the commands stored in the trigger buffer. If queries are also contained in the buffer, the corresponding responses will be prepared; these must then be read.

*TST?

Self-Test Query

<NR1 NUMERIC RESPONSE DATA> *TST?; 0;	Reads out the result of the switch-on self test. "0" indicates that the test was successful. A result other than "0" indicates an error.

*WAI

Wait-to-Continue Command

:PRESET$_U$2048; *WAI; :START;	Wait until device has assumed idle state. The wait command causes the measurement to be delayed until the hardware has settled after being set.

4.3.4 Data output

The following data outputs are not the responses to normal queries of setting parameters given in section 4.3.3 "Common commands".

They are special compound commands for data outputs. A special case is the output queue for alarm data.

Output queue principle

Information (in this case alarm data) is placed in a queue. The presence of data in the queue is indicated in the status message (bit 0 of status byte register STB). If the queue is empty, bit 0 (AAV, alarm available) is set to 0. If the queue contains alarms, bit 0 is set to 1. The queue is cleared after the alarms have been read out.

Note: The output queue status must be queried using *STB?; **before** the alarm queue is read out using :ALARM:QUE?;. If the status is 0, the output queue cannot be read out.

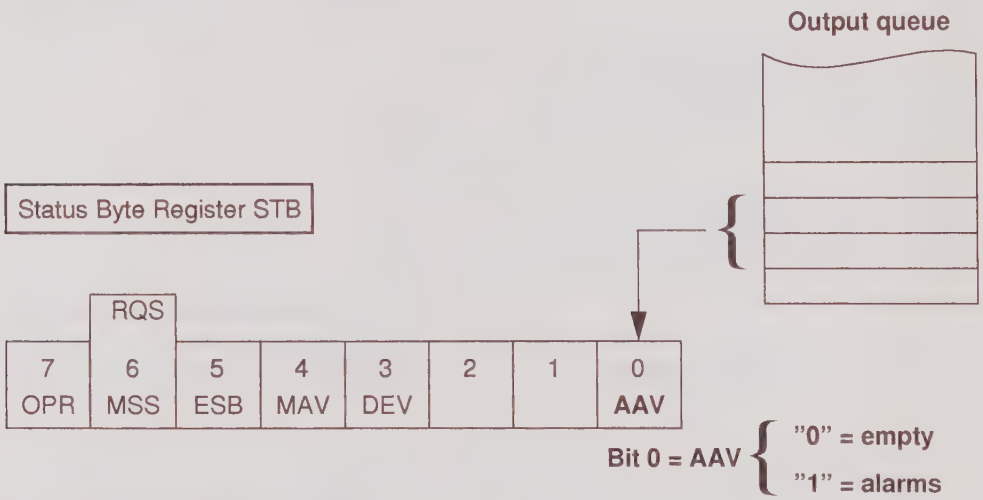


Fig. 4-17 Output queue

4.3.4.1 Results

The SF-60 generates a set of results every second. The set depends on the measurement setting.

A distinction is made between current results and final results. The final results are available at the end of the gate time for REP-N and single measurements.

The selection of the results is determined by the data output mask (:RSLT:MASK ...;).

The query :RSLT:ACT?; causes the SF-60 to respond with the next set of results which occurs. This can be a final result if the gate time ends at this point.

The query :RSLT:END?; causes the SF-60 to respond with the final results on completion of the gate time.

Result status

Each individual result has a status:

"<status>,<value>;"

The status may assume the following values:

Value	<Result status>	Explanation
0	RSLT_OK	Result is valid.
1	NO_RSLT	No result available
2	OVERFLW	- A measurement time of more than 10 s has occurred for a delay measurement (DLY). - The measured value of an offset measurement is outside the specified range (-999 to +999 ppm). - Maximum drive conditions for MTJ result have occurred.
3	NO_VAL	A first result is not yet available, as all previous results were compensated (when alarm present at start of measurement).
4	AL_TMP	Results are being compensated due to the presence of an alarm.
5	AL_MEM	Alarm memory: At some time during the measurement a result was compensated due to an alarm.
6	NOT_EXACT	- Bit rate measurement not yet completed; measured value not exact. - Offset measurement not yet completed; measured value not exact. - No error has occurred up to the point where the error rate result is output.

Overall status

The overall status "<STATUS>" is additional to the result status and may assume the following values:

Value	<Overall status>	Explanation
0		Current result within a START/STOP measurement
1		Final result of a START/STOP measurement.
3		Final result lost (this can occur if extreme device settings are chosen, e.g. if a gate time of 0.2 s is set for a REP-N measurement).

:RSLT:ACT? **Output of intermediate results**

(corresponds to:RSLT:MASK)	Output format is determined by the :RSLT:MASK ...; command

:RSLT:END? Output of final results

(corresponds to:RSLT:MASK) **(RSLT:MASK$_U$STATUS,RXOFFS,BEC,BER;)** **RSLT:END?;** 1,0,+35,0,1.392688E+06,0,+1.000034-03; (see figure 4-18)	Output format is determined by the :RSLT:MASK$_U$ ...; command If a measurement is in progress, command causes output of next final result. If no measurement is in progress, command causes output of last available final result.

:G821:ACT? Output of G.821 intermediate results

Example: 1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0; EFS0 ES0 SES0 CSES0 UAS0 DM0 EFS0 RES0 RSES0 RUAS0 RDM0R	Command corresponds to the output of an intermediate result.

:G821:END? Output of G.821 final results

Example: 1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0,1,0; EFS0 ES0 SES0 CSES0 UAS0 DM0 EFS0 RES0 RSES0 RUAS0 RDM0R	Command corresponds to the output of a final result with.

:RSLT:MTJ? Output tolerance to jitter measurement results

<NR2 NUMERIC RESPONSE DATA> <Status>,<jitter frequency>,<jitter amplitude> 3 fields separated by commas (,): :RSLT:MTJ?; 0,0.100,10.0; Jitter amplitude <NR2> in UI Jitter frequency <NR2> in kHz Result status (see section 4.3.4.1)	If a measurement is in progress, command causes output of next final result. If no measurement is in progress, command causes output of last available final result.

:RSLT:MASK

<param> **Setting the data output mask**

:RSLT:MASK$_U$<RM list>; (= result mask list)	The data output mask determines the data and the format of the result output. Data can be requested using :RSLT:ACT?; or :RSLT:END?;.
:RSLT:MASK$_U$STATUS,RXOFFS,BEC,BER;	A result element is output for each output element included in :RSLT:MASK ...; in the same order of the list. Each result comprises result status and result value
1,0,+35,0,1.392688E+06,0,+1.000034-03; (see Figure 4-18)	The overall status is placed before the result list.

:RSLT:MASK? **Query of data output mask**

<RM list> :RSLT:MASK?; STATUS,RXOFFS,BEC,BER;	Output of data output mask as set by :RSLT:MASK

Example: Data output

Setting the data output mask and querying the final result:

RSLT:MASK$_U$STATUS,RXOFFS,BEC,BER;END?;

Output of the resul

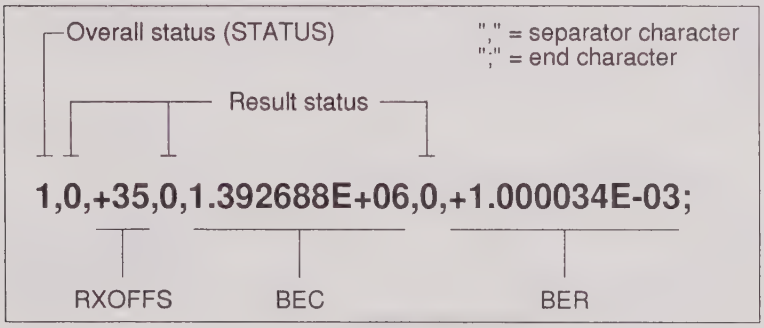


Fig. 4-18 Result output using :RSLT:END?

Output		Meaning	
Overall status	= 1	Final result of a START/STOP measurement	
Result status	= 0	Result is valid (separate for each individual result)	
RXOFFS	= +35	Offset	= +35 ppm
BEC	= 1.392688E+06	Bit error count	= 1.392688E+06
BER	= +1.000034E-03	Bit error ratio	= 1.000034E-03

:RSLT:STORED? Output of result memory (command not used from software version 3.000 onwards)

<a, b, c, d, e, f> 6 fields separated by commas (,) :RSLT:STORED?; 6,5,20.12.91,11:17:26:1,20.12.91,11:17:36:1; (see figure 4-19)	a = total number of results b = current result number Parameters for current result numbers: c = start date d = start time e = stop date f = stop time

Example: Memory output

Query of stored result

:RSLT:STORED?

Output of result:

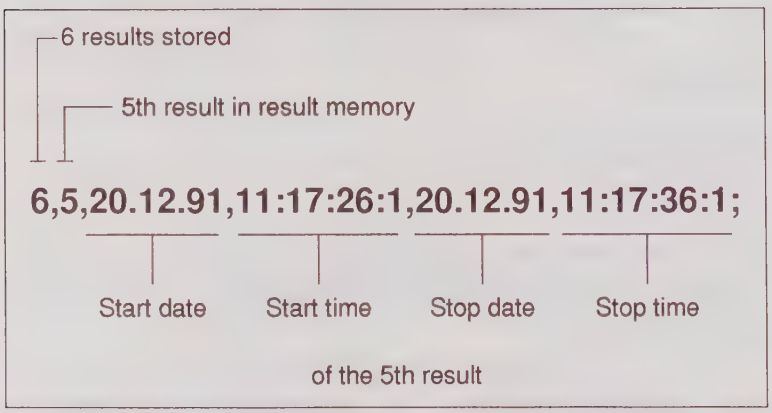


Fig. 4-19 Result output using :RSLT:STORED?

:HCOPY:DATA? Output of a screen dump of SF-60

< x,y > x = Index of row (0 - 199) y = 160 characters in ASCII-HEX format Example output: 0,123456789ABCDEF..... ; First row — 160 characters (= 640 pixel) in ASCII-HEX format Commands used: :HCOPY:DATA? 0; :HCOPY:DATA?	Output of screen contents in ASCII-HEX format of every row of the screen. Resolution: 640x200 pixel Output of first row (0) Output of next row

Output of overhead (option)

Complete output of SOH and POH

The SOH and POH (90 bytes) are output wit the command:

:RSLT:MASK$_U$SOH_POH;ACT?;

The VC3_POH bytes are output with the command:

:RSLT:MASK$_U$VC3_POH;ACT?;

64 byte sequence from SOH and POH

The following settings must be made in advance in order to output a 64 byte sequence from the overhead:

Program word	Parameter	Query	Explanation
:FRM_OH:R_C:RSLT U *Parameter 1* *Parameter 2*	1,1; *Row,* *Column;*	yes	Byte position Any entry: Row = 1 to 9 Column = 1 to 10 (10 = POH) C-3: 1 to 11 (11 = VC3_POH)
:RSLT:MASK U *Parameter ...*	R_C_SEQ, *<RM list>;*	yes	Output selected byte (optional)

Example: 64 byte sequence

SF-60 setting commands:

1 :FRM_OH:R_C:RSLT$_U$1,1; Row 1, Column 1
2 :RSLT:MASK$_U$R_C_SEQ;ACT?; Data output mask; final result

Output of result:

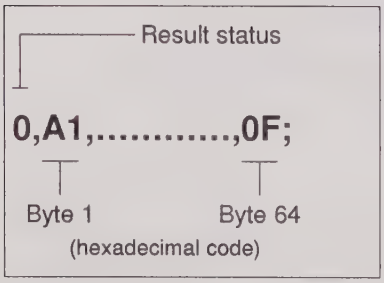


Fig. 4-20 64 byte sequence output using:RSLT:ACT?;

1 byte from the SOH or POH

To output one byte from the SOH or POH, the byte position must be selected first:

Program word	Parameter	Query	Explanation
:FRM_OH:R_C:RSLT U *Parameter 1* *Parameter 2*	1,1; *Row,* *Column;*	yes	Byte position Any entry: Row = 1 to 9 Column = 1 to 10 (10 = POH) C-3: 1 to 11 (11 = VC3_POH)
:RSLT:MASK U *Parameter ...*	R_C_BYTE, *<RM list>;*	yes	Output selected byte (optional)

Example: SOH byte

1 byte of the data channel (D3) in the SOH is to be output.

SF-60 setting commands:

1 :FRM_OH:R_C:RSLT$_U$3,7; Row 3, Column 7 (D3)
2 :RSLT:MASK$_U$R_C_BYTE;ACT?; Data output mask; result

Output of result:

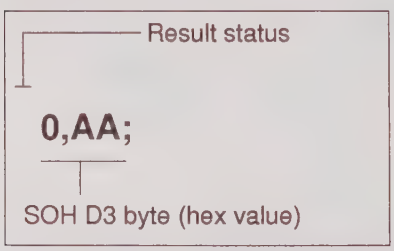


Fig. 4-21 SOH byte output using:RSLT:ACT?;

Output of VC12 POH (bits 4 to 8 of byte V5)

The output of the VC-12 POH is made using the command:

:RSLT:MASK$_U$VC12_POH;ACT?

Output of result:

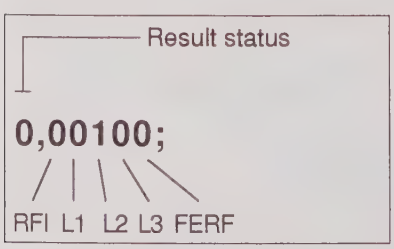


Fig. 4-22 VC12 POH output using:RSLT:ACT?;

Overhead byte comparison

Any byte in the overhead ca<n be compared with a pre-set bit pattern.
The following settings must be made first:

Program word	Parameter	Query	Explanation
:OHC:R_C_MASK U	1,1,"1XXX0001";	yes	Overhead compare Position / byte Any entry:
Parameter 1	*Row,*		Row = 1 to 9
Parameter 2	*Column,*		Column = 1 to 10 (10 = POH)
Parameter 3	*"Byte";*		Byte = binary 1 or 0; X = don't care
:RSLT:MASK U	OHC_MC,	yes	Output of number of identical bytes
	OHC_UMC,		Output of number of non-identical bytes (optional)
Parameter ...	*<RM list>;*		

Example: Overhead byte comparison

Compare D10 byte from SOH with pattern "10XX0X01".

SF-60 setting commands:

:OHC:R_C_MASK$_U$8,1,"10XX0X01"; Selection of byte and comparison mask

:RSLT:MASK$_U$OHC_MC;END?; Output of the number of identical bytes (or non-identical bytes using :RSLT:MASK$_U$OHC_UMC;END?;)

The bit positions indicated by "X" are ignored in the comparison.

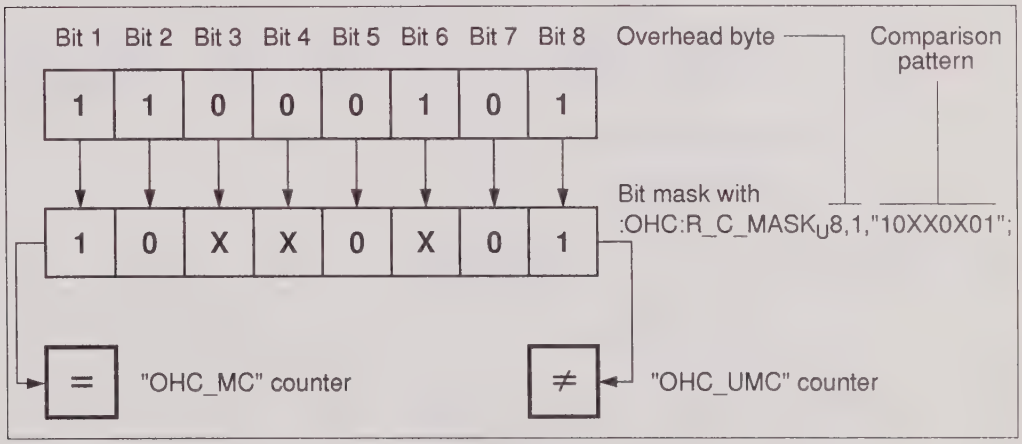

Bit 1 Bit 2 Bit 3 Bit 4 Bit 5 Bit 6 Bit 7 Bit 8
Overhead byte
Comparison pattern
1 1 0 0 0 1 0 1
Bit mask with
:OHC:R_C_MASKU8,1,"10XX0X01";
1 0 X X 0 X 0 1
=
"OHC_MC" counter
≠
"OHC_UMC" counter

Fig. 4-23 Overhead byte comparison

Output of result:

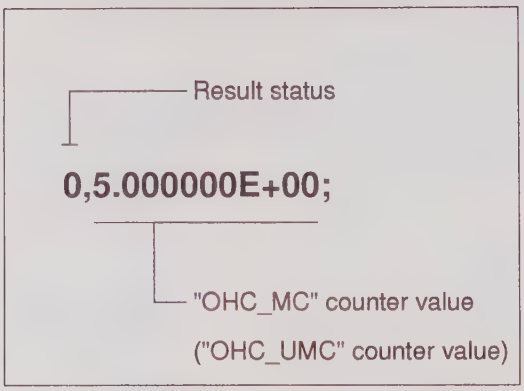


Fig. 4-24 Output of "OHC_MC" and "OHC_UMC" counter values with :RSLT:END?;

Output of Sa bit pattern (option)

The position of the S_a bit must first be selected:

Program word	Parameter	Query	Explanation
:FRM:RX:SA_POS U	OFF;	yes	S_a bit position Any entry: 4 to 8

Example: Sa bit pattern

The S_a bit pattern in position 5 of the NFAS is to be output.
SF-60 setting commands:

:FRM:RX:SA_POS$_U$5;	Position 5
:RSLT:MASK$_U$SA;ACT?;	Data output mask; result

Output of result:

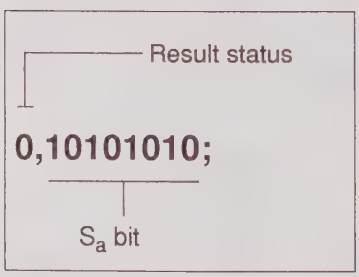


Fig. 4-25 S_a bit output using :RSLT:ACT?;

Data output parameters (<RM list>)

Abbreviations used in the RM list:

<N1> : = < NR1 NUMERIC RESPONSE DATA>
Range: 0 to 65535

<N3> : = <NR3 NUMERIC RESPONSE DATA>
Always 7 digit mantissa:
[s]m.mmmmmmEsee
s = sign (+ or -),
m = mantissa,
ee = exponent.

M.Int. = Main interval
I.Int. = Intermediate interval

Meanings of the columns in the RM list:

- Parameter : Parameters for the program word :RSLT:MASK$_U$...;
- Measured values: Measured values to be output
- Syntax : Data output syntax (see note below)
- Format : Data output format to IEEE 488.2
- Unit : Units of results
- * : Result can be queried with :RSLT:ACT?; and :RSLT:END?;

Note: With the exception of the overall status, a result status is assigned to each result:

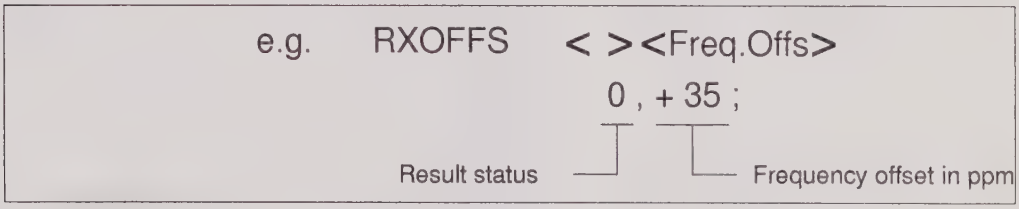


Fig. 4-26 Result status

RM list

Parameter/Altered in software version	Measured values	Syntax (see note)	Format	Unit	*
STATUS	Overall status	< > <Ov. status>	<N1>	-	
REPI	RepN index	< > <Index>	<N1>	-	*
ELAPTIME		< > <Time>	<N1>	s	*
TXEXT	TX bit rate external	< > <Frequency>	<N1>	Hz	
RXEXT	RX bit rate external	< > <Frequency>	<N1>	Hz	
RXOFFS	RX bit rate offset	< > <Freq. offs>	<N1>	ppm	
DSAMP	RX digital signal amplitude	< > <Amplitude>	<N1>	mV	
DLY	Delay time	< > <Delay>	<N3>	ms	
SLIP	Slip count	< > <Count>	<N3>	-	
EXT	External error count	< > <Count>	<N3>	-	*
BEC	Bit error count	< > <Count>	<N3>	-	*
BER	Bit error ratio	< > <Ratio>	<N3>	-	*
CEC	Code error count	< > <Count>	<N3>	-	*
CER	Code error ratio	< > <Ratio>	<N3>	-	*
BLEC	Block error count	< > <Count>	<N3>	-	*
BLER	Block error ratio	< > <Ratio>	<N3>	-	*
ALSC	Alarm seconds count	< > <Count>	<N3>	-	*
ALSR	Alarm seconds ratio	< > <Ratio>	<N3>	-	*
FASWC 3x	FAS word error count compatible with: FASWC_2M FASWC_8M FASWC_34M FASWC_140M FASWC_STM1	< > <Count>	<N3>	-	*
FASWR 3x	FAS word error ratio compatible with: FASWR_2M FASWR_8M FASWR_34M FASWR_140M FASWR_STM1	< > <Ratio>	<N3>	-	*
AN 3x	AN bits compatible with: DN_8M DN_34M	< > <AN>	<N1>	-	*
STFR 3x	Stuffing rate compatible with: STFR_8M STFR_34M STFR_140M	< > <Rate>	<N1>	bit/s	*

Parameter/Altered in software version	Measured values	Syntax (see note)	Format	Unit	*
	For 2 Mbit/s channels:				
FASWC_2M	FAS word error count	< > <Count>	<N3>	-	*
FASWR_2M	FAS word error ratio	< > <Ratio>	<N3>	-	*
FASBC_2M	FAS bit error count	< > <Count>	<N3>	-	*
FASBR_2M	FAS bit error ratio	< > <Ratio>	<N3>	-	*
CRCWC	CRC word error count	< > <Count>	<N3>	-	*
CRCWR	CRC word error ratio	< > <Ratio>	<N3>	%	*
CRCBER	CRC bit error ratio	< > <Ratio>	<N3>	-	*
EBEC	E bit count	< > <Count>	<N3>	-	*
EBER	E bit ratio	< > <Ratio>	<N3>	-	*
NFAS	NFAS bits	< > <345678>	<N1>	-	*
SA[1]	S_a bits	< > <12345678>	<N1>	-	*
	For 8 Mbit/s channels:				
FASWC_8M	FAS word error count	< > <Count>	<N3>	-	*
FASWR_8M	FAS word error ratio	< > <Ratio>	<N3>	-	*
FASBC_8M	FAS bit error count	< > <Count>	<N3>	-	*
FASBR_8M	FAS bit error ratio	< > <Ratio>	<N3>	-	*
DN_8M	DN bits	< > <DN bits>	<N1>	-	*
STFR_8M	Stuffing rate	< > <Rate>	<N1>	bit/s	*
	For 34 Mbit/s channels:				
FASWC_34M	FAS word error count	< > <Count>	<N3>	-	*
FASWR_34M	FAS word error ratio	< > <Ratio>	<N3>	-	*
FASBC_34M	FAS bit error count	< > <Count>	<N1>	-	*
FASBR_34M	FAS bit error ratio	< > <Ratio>	<N1>	bit/s	*
DN_34M	DN bits	< > <DN bits>			*
STFR_34M	Stuffing rate	< > <Rate>			*
	For 140 Mbit/s channels:				
FASWC_140M	FAS word error count	< > <Count>	<N3>	-	*
FASWR_140M	FAS word error ratio	< > <Ratio>	<N3>	-	*
FASBC_140M	FAS bit error count	< > <Count>	<N3>	-	*
FASBR_140M	FAS bit error ratio	< > <Ratio>	<N3>	-	*
DNYY	DNYY bits	< > <DNYY bits>	<N1>	-	*
STFR_140M	Stuffing rate	< > <Rate>	<N1>	bit/s	*

Parameter/Altered in software version	Measured values	Syntax (see note)	Format	Unit	*
	For STM-1 channel:				
FASWC_STM1	FAS word error count	< > <Count>	<N3>	-	*
FASWR_STM1	FAS word error ratio	< > <Ratio>	<N3>	-	*
FASBC_STM1	FAS bit error count	< > <Count>	<N3>	-	*
FASBR_STM1	FAS bit error ratio	< > <Ratio>	<N3>	-	*
B1C	B1 bit error count	< > <Count>	<N3>	-	*
B1R	B1 bit error ratio	< > <Ratio>	<N3>	-	*
B2C	B2 bit error count	< > <Count>	<N3>	-	*
B2R	B2 bit error ratio	< > <Ratio>	<N3>	-	*
B3C	B3 bit error count	< > <Count>	<N3>	-	*
B3R	B3 bit error ratio	< > <Ratio>	<N3>	-	*
LP_B3C	B3 bit error count C-3	< > <Count>	<N3>	-	*
LP_B3R	B3 bit error ratio C-3	< > <Ratio>	<N3>	-	*
FEBEC	FEBE count	< > <Count>	<N3>	-	*
2x	must be replaced with HP_FEBEC				
3x	compatible with HP_FEBEC				*
HP_FEBEC	FEBE count C-4, C-12, C-3	< > <Count>	<N3>	-	*
HP_FEBER	FEBE ratio C-4, C-12, C-3	< > <Ratio>	<N3>	-	*
LP_FEBEC	FEBE count C-12, C-3	< > <Count>	<N3>	-	*
LP_FEBER	FEBE ratio C-12, C-3	< > <Ratio>	<N3>	-	*
LP_BIPC	BIP2 error count C-12	< > <Count>	<N3>	-	*
LP_BIPR	BIP2 error ratio C-12	< > <Ratio>	<N3>	-	*
P_PTR	pos. pointer count C-4, C-12, C-3	< > <Count>	<N3>	-	*
N_PTR	neg. pointer count C-4, C-12, C-3	< > <Count>	<N3>	-	*
PN_PTR	pos./ neg. pointer count C-4, C-12, C-3	< > <Count>	<N3>	-	*
OHC_MC[2]	Overhead byte comparison	< > <Count>	<N3>	-	*
OHC_UMC[2]	Overhead byte comparison	< > <Count>	<N3>	-	
AU_PTR_ABS	Absolute pointer C-4, C-12, C-3	< > <123>	<N1>	-	
TU_PTR_ABS	Absolute pointer C-12, C-3	< > <123>	<N1>	-	
VC12_POH[3]	V5 bit 4 to Bit 8 C-12	< > <5 Bits>	<N1>	-	
VC3_POH	VC3 POH output	<> <9 Bytes>	<N1>	-	
SOH_POH	SOH and POH output	< > <90 Bytes>	<N1>	-	
R_C_SEQ[4]	64 byte hex sequence	< > <64 Bytes>	<N1>	-	
R_C_BYTE[4]	1 byte of overhead	< > <1 Byte>	<N1>	-	
STM_BYTE	SOH or POH byte	< > <Byte>	<N1>	-	
2x	compatible with R_C_BYTE				
3x	compatible with STM1_Byte				
STM1_BYTE		< > <Byte>	<N1>	-	
EFS0C	G.821 M.Int. 0 EFS count	< > <Count>	<N3>	-	*
EFS0R	G.821 M.Int. 0 EFS ratio	< > <Ratio>	<N3>	-	*
ES0C	G.821 M.Int. 0 ES count	< > <Count>	<N3>	-	*
ES0R	G.821 M.Int. 0 ES ratio	< > <Ratio>	<N3>	-	*
SES0C	G.821 M.Int. 0 SES count	< > <Count>	<N3>	-	*
SES0R	G.821 M.Int. 0 SES ratio	< > <Ratio>	<N3>	-	*
US0C	G.821 M.Int. 0 US count	< > <Count>	<N3>	-	*
US0R	G.821 M.Int. 0 US ratio	< > <Ratio>	<N3>	-	*
DM0C	G.821 M.Int. 0 DM count	< > <Count>	<N3>	-	*
DM0R	G.821 M.Int. 0 DM ratio	< > <Ratio>	<N3>	-	*

RM list (continued)

Parameter/Altered in software version	Measured values	Syntax (see note)	Format	Unit	*
	G.826 evaluation:				
BBEC	Background Block Error Count	< > <Count>	<N3>	-	*
BBER	Background Block Error Ratio	< > <Ratio>	<N3>	-	*
EBC	Errored Block Count	< > <Count>	<N3>	-	*
EBR	Errored Block Ratio	< > <Ratio>	<N3>	-	*
ESC	Errored Seconds Count	< > <Count>	<N3>	-	*
ESR	Errored Seconds Ratio	< > <Ratio>	<N3>	-	*
SESC	Severely Errored Seconds Count	< > <Count>	<N3>	-	*
SESR	Severely Errored Seconds Ratio	< > <Ratio>	<N3>	-	*
EFSC	Error Free Seconds Count	< > <Count>	<N3>	-	*
EFSR	Error Free Seconds Ratio	< > <Ratio>	<N3>	-	*
US	Unavailable Seconds Count	< > <Count>	<N3>	-	*
PATH	Path assessment	< > <Count> accepted = <0> uncertain = <1> rejected = <2>	<N1>	-	*

1)Select S_a bit position using :FRM:RX:SA_POS$_U$...
2)Selection of row and column using :OHC:R_C_MASK$_U$Row,Column,"Byte"; (see p. 4-69)
3)Output of VC-12 POH using :RSLT:MASK$_U$VC12_POH;ACT? (see p. 4-68)
4)Selection of row and column using :FRM_OH:R_C:RSLT$_U$Row,Column; (see p. 4-67)

4.3.4.2 Alarms

Alarm assignment table: priorities see section 8.2.4.2 "Stored Alarms"

Alarm no.	Assignment	Altered in software version:	Alarm no.	Assignment	Altered in software version:
0	No alarm		17	LOM	
1	No signal		18	TU-LOP	
2	No clock		19	TU-AIS	
3[1]	No signal (micro-interrupt)		20	LP-FERF	
			21	LP-UENQ	
4	Micro-interrupts		22	RAI (D-ALARM 140M)	
5	AIS	3.x: AIS_140M	23	Power fail	
6	SAIS	2.x: MS-AIS	24	LOF-140M	
7	PAIS	2.x: AU-AIS	25	LOF-34M	
8	No frame synchronization		26	LOF-8M	
		3.x: LOF-STM1	27	LOF-2M	
9	FERF	2.x: MS-FERF	28	AIS_34M	
10	LOP	2.x: AU-LOP	29	AIS_8M	
11	PRAI	2.x: HP-FERF	30	AIS_2M	
12	UIS	2.x: HP-UNEQ	31	RAI_34M	
13	Pattern AIS		32	RAI_8M	
14	Pattern ZERO		33	RAI_2M	
15[1]	Pattern SLIP		34	OOF	
16	No pattern synchronization				

1)Dynamic alarm (registered with start time only)

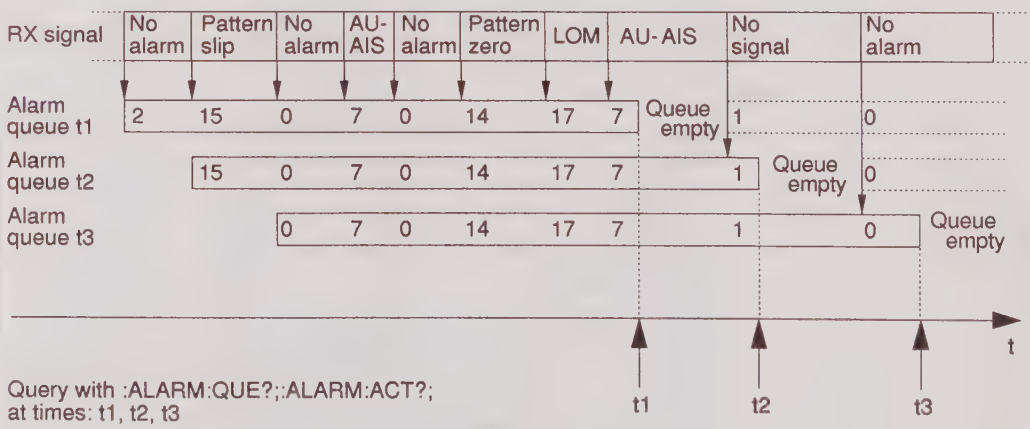
:ALARM:ACT? Output of current alarm

<NR1 NUMERIC RESPONSE DATA> <Alarm no.>; :ALARM:ACT?; 0;	Output of current alarm status of SF-60. "0" = no alarms (see alarm assignment table)

:ALARM:QUE? Output of alarm queue

<NR1 NUMERIC RESPONSE DATA> <Alarm no.>[,<Alarm no.>]...; :ALARM:QUE?; 1,3,4;	Alarms are collected in the alarm queue. If alarms have occured, the AAV bit in status byte register STB = "1" (query using *STB?;). *Notes:* - The output queue status **must** be queried using *STB?; before the alarm queue is read out! - A maximum of the last 8 alarms are stored in the alarm queue - Each alarm is stored as it occurs (alarm start) - The alarm queue is independent of any start-stop measurement After being read out, the alarm queue is cleared. (see alarm assignment table)

Example:



Query with :ALARM:QUE?;:ALARM:ACT?;
at times: t1, t2, t3

Response to t1: 2,15,0,7,0,14,17,7;7;

Response to t2: 15,0,7,0,14,17,7,1;1;

Response to t3: 0,7,0,14,17,7,1,0;0;

:ALARM:PAST? Output of alarm monitor

<a, b, c, d, e, f, g> 7 fields separated by commas (,) :ALARM:PAST?; 4,2,1,22.12.91,13:16:10,23.12.91,01:11:51; Example: see figure 4-27	a = total number of alarms b = current alarm number c = alarm no. (see assignment table) d = start date e = start time f = stop date g = stop time *Notes:* -Up to 30 alarms are stored - Alarms are cleared by :CLR:STO_EV; or :START; of a new measurement - The content of the alarm monitor refers to a start-stop measurement

Example: Output of alarm monitor

The alarms stored during a measurement are output:

:ALARM:PAST?

Output of result:

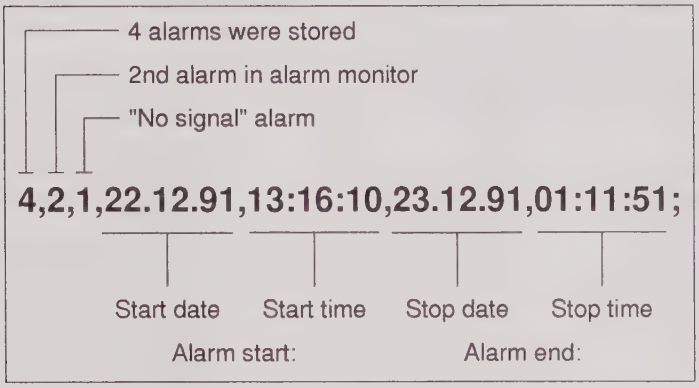


Fig. 4-27 Result output using :ALARM:PAST?;

4.3.4.3 Error messages

:ERR:CME? **Output of command errors**

<NR1 NUMERIC RESPONSE DATA>, <STRING RESPONSE DATA> <Error no.>, <Command String> :ERR:CME? 100,":TX:BRT64;" 0,""; 	Command errors are not overwritten. They are retained until the first error which occurred is read out. The presence of a command error can be seen from bit 5 of the standard event status register ESR (*ESR?) <Command string> is the input string containing the incorrect command. 100 = Error number = Unknown command (see section 3.4 "Error messages"). ":TX:BRT64;" is the errored string. Every command error can trigger a SRQ interrupt. *CLS clears the ESR and any command errors present. No command error present: Error no. = 0, empty string

:ERR:EXE? **Output of execution errors**

<NR1 NUMERIC RESPONSE DATA>, <STRING RESPONSE DATA> <Error no.>, <Command String> :ERR:EXE? 620,":LRN?;" 0,""; 	Execution errors are not overwritten. They are retained until the first error which occurred is read out. The presence of an execution error can be seen from bit 4 of the standard event status register ESR (*ESR?) <Command string> is the input string containing the incorrect command. 620 = Error number = Learn string contains illegal data. ":LRN?;" is the errored string. Every execution error can trigger a SRQ interrupt. *CLS clears the ESR and any execution errors present. No execution error present: Error no. = 0, empty string

4.3.5 Status register

4.3.5.1 Status register structure

The remote control system for the SF-60 uses the status reporting system defined in IEEE 488.2, section 11.

A further 3 bits in the status byte register are used:

1 Bit 0 with AAV (alarm available)
2 Bit 3 with DEV (device status)
3 Bit 7 with OPR (operation status)

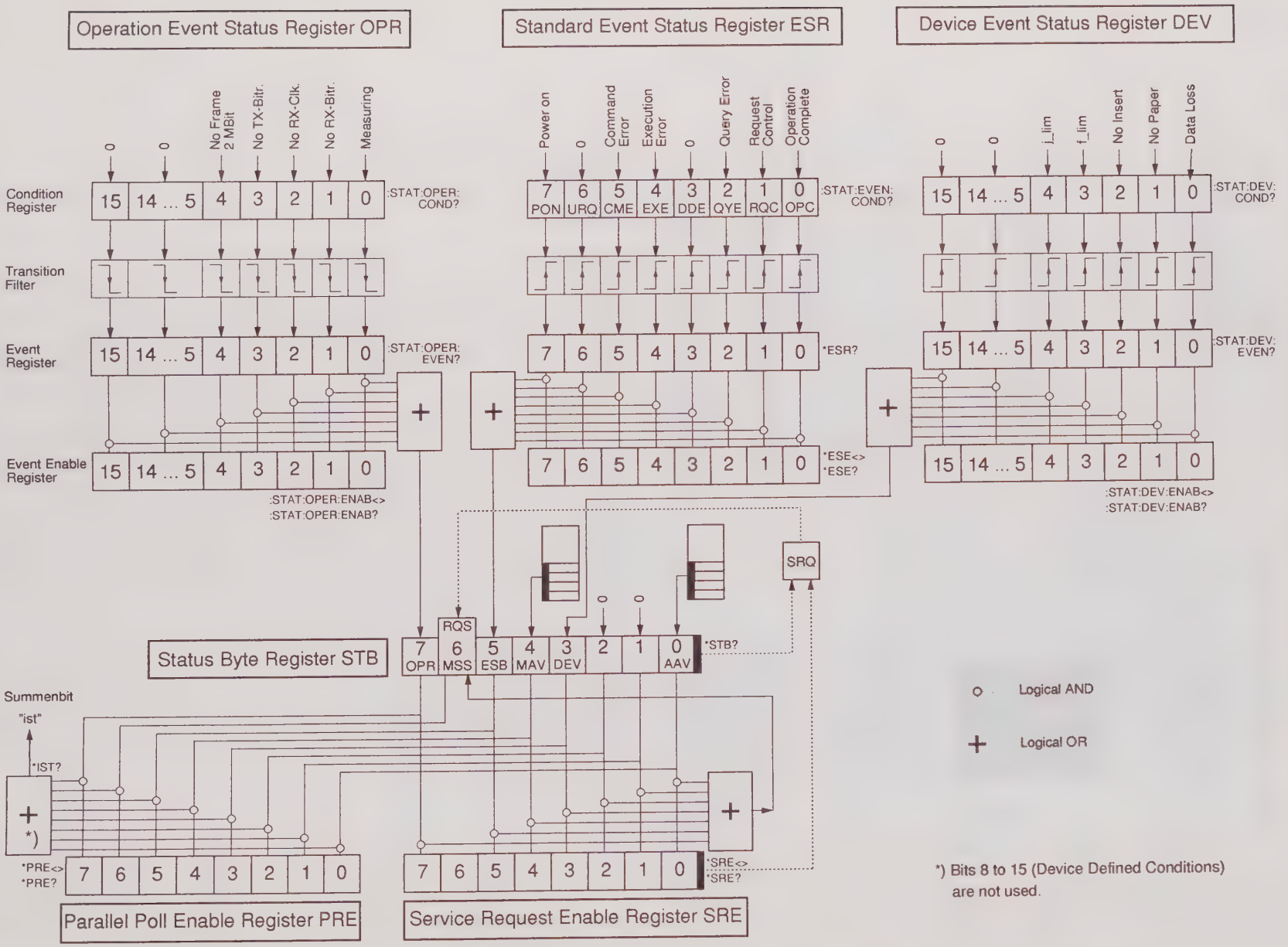
The three registers OPR Operation Event Status Register
ESR Standard Event Status Register
DEV Device Event Status Register

are identical in structure, and comprise:

Register	Meaning
Condition Register	Contains the actual status of the SF-60
Transition Filter	Specifies the signal edge used for storing to the event register (contiguous for a change in one direction)
Event Register	Stores the condition register, i.e. status changes are stored until read out by a query.
Enable Register	Contains the mask for the event register, i.e. serves as a switch for masking the content of the event register into the status byte register.

The status system of the SF-60 is shown diagramatically on page 4-80.

The status system of the SF-60



Register commands for the status system

Register type	OPR	ESR	DEV
Condition Register	:STAT:OPER:COND?;	:STAT:EVEN:COND?;	:STAT:DEV:COND?;
Event Register	:STAT:OPER:EVEN?;	*ESR?;	:STAT:DEV:EVEN?;
Event Enable Register	:STAT:OPER:ENAB<>; :STAT:OPER:ENAB?;	*ESE<> *ESE?;	:STAT:DEV:ENAB<>; :STAT:DEV:ENAB?;
Status Byte Register	*STB?; (Query Status Byte Register)		
Service Req. Enable Register	*SRE<>; *SRE?;		
Individual Status	*IST?; (Query "ist" sum bit)		
Parallel Poll Enable Register	*PRE<>; *PRE?;		
Clear Status Command	*CLS; (Clears all event registers)		
Power-On Status clear	*PSC<>; (Sets the Power-On Status Clear Flag; *PSC?; affects register initialization at power on)		

The commands indicated by <> contain the parameters for masking the registers or the power on behavior.

Examples: :STAT:OPER:ENAB$_U$31;
:STAT:DEV:ENAB$_U$31;
*ESE$_U$183;
*SRE$_U$185;
*PRE$_U$255;
*PSC$_U$0;

4.3.5.2 Status Byte Register STB

Realization corresponds to IEEE 488.2 section 11.2
Bit assignments are shown on page 4-80.

Register commands

Command	Meaning
*STB?;	Read out Status Byte Register STB is cleared by * CLS The Status Byte Register is not altered by being read out.
*SRE< >; *SRE?;	Set Service Request Enable Register Read Service Request Enable Register
	Example: *SRE␣8; Bit 3 (2^3) is set *SRE?; 8;

STB assignments

Bit	Meaning	Explanation
0	AAV	Alarm Available (see section 4.3.5.7 "Alarm available AAV")
1		not used
2		not used
3	DEV	Device Event Status (see section 4.3.5.6 "Device event status register DEV")
4	MAV	Message Available (see section 4.3.5.5 "Message available MAV")
5	ESB	Standard Event Status (see section 4.3.5.4 "Standard event status register ESR")
6	MSS	Master Summery Status: Maskable summary of the sum bit which is only output in bit 6 of the status byte when read out using *STB?
	RQS	Request Service: Corresponds to the RQS line of the IEEE bus and is set when one of the sum bits changes to state "1". After a serial poll, MSS and RQS are no longer identical, since RQS is cleared.
7	OPR	Operation Event Status (see section 4.3.5.3 "Operation event status register OPR")

4.3.5.3 Operation Event Status Register OPR

All of the operation states which are also used for the No Pending Operation Flag are available in the Operation Event Status Register

Only transitiions from "1" to "0" (negative edge) are stored in the event register.

COND = "0" indicates status is o.k.

Register commands

Command	Meaning
:STAT:OPER:EVEN?;	Read out Operation Event Status Register OPR; clears register.
:STAT:OPER:COND?;	Read out Condition Register
:STAT:OPER:ENAB< >;	Set Event Enable Register
:STAT:OPER:ENAB?;	Read Event Enable Register

OPR assignments

Bit	Meaning	Explanation
0	Measuring	Measurement in progress
1	No RX bit rate	Internal RX bit rate not valid
2	No RX clock	External RX clock not valid
3	No TX bit rate	Internal TX bit rate not valid
4	No Frame 2MBit	2 Mbit/s frame not valid
5 - 14	- - - -	Free for extension; status = "0"
15	reserved	Reserved; status always = "0"

4.3.5.4 Standard Event Status Register ESR

Realization corresponds to IEEE 488.2 section 11.2

Bit assignments are shown on page 4-80.

Register commands

Command	Meaning
*ESR?;	Read out Standard Event Status Register ESR; clears register
*ESE< >;	Set Event Enable Register
*ESE?;	Read Event Enable Register
:STAT:EVEN:COND?;	Read out Condition Register
	Example: *ESE$_U$4; Set bit 2 (2^2) *ESE?; 4; :STAT:EVEN:COND?; 4;

ESR assignments

Bit	Meaning	Explanation
0	OPC	Operation Complete: Indicates that all internal setting functions and measurements have been completed (see also section 4.3.5.3 "Operation event staus register" and IEEE 488.2, section 11.5.1.1.9)
1	RQS	Request Control: Only for controlling an external printer. Requests the control function from the controller (see IEEE 488.2, sect. 11.5.1.1.8)
2	QYE	Query Error: Indicates errors in data output, e.g. queue overflow or response to query not fetched (see IEEE 488.2, sect. 11.5.1.1.7)
3	DDE	Device Dependent Error: Not used in SF-60. Static error and device states are indicated using the SF-60 specific Operation Event Status Register OPR (see IEEE 488.2, sect. 11.5.1.1.6)
4	EXE	Execution Error: Output for every execution error/parameter error, one error being stored each time. This can be read out using :ERR:EXE?. The error cannot be overwritten until it has been read out (see IEEE 488.2, sect. 11.5.1.1.5)
5	CME	Command Error: Output for every command error, one error being stored each time. This can be read out using :ERR:CME?. The error cannot be overwritten until it has been read out (see IEEE 488.2, sect. 11.5.1.1.4)
6	URQ	User Request Not used in the SF-60. Indicates a request for the controller caused by operating a control on the device (see IEEE 488.2, sect. 11.5.1.1.3)
7	PON	Power On: Indicates that the SF-60 was switched on or that power has returned after a power failure (see IEEE 488.2, sect. 11.5.1.1.2)

4.3.5.5 Message Available MAV

Realization corresponds to IEEE 488.2 section 11.5.2.
MAV indicates the presence of data in the output queue.
See also section 4.3.4 "Data output".

Bit state	Explanation
"0"	No data in output queue; read operation not possible.
"1"	Data in output queue; read operation possible.

4.3.5.6 Device Event Status Register DEV

The Device Event Status Register DEV contains all device states which possess an error characteristic and which affect instrument behavior.
Only transitiions from "0" to "1" (positive edge) are stored in the event register.
COND = "0" indicates status is o.k.

Register commands

Command	Meaning
:STAT:DEV:EVEN?;	Read out Device Event Status Register DEV; clears register
:STAT:DEV:COND?;	Read out Condition Register
:STAT:DEV:ENAB< >;	Set Event Enable Register
:STAT:DEV:ENAB?;	Read Event Enable Register

DEV assignments

Bit	Meaning	Explanation
0	Data Loss	Data loss. The status of the buffered RAM is checked after power on. If there is an error, this bit is set to "1".
1	No Paper	No paper in built-in printer
2	No Insert	No error insertion possible
3	f_lim	External modulation frequency too high
4	j_lim	External modulation amplitude too high
5 - 14	- - - -	Free for extension; status = "0"
15	reserved	Reserved; status always = "0"

4.3.5.7 Alarm Available AAV

An alarm output queue as per IEEE 488.2 is implemented for the alarm output. AAV indicates the presence of alarms in the output queue.

Bit state	Explanation
"0"	No alarms in output queue, read operation not possible!
"1"	Alarms in output queue; read operation possible.

4.3.6 Synchronization mechanisms

The SF-60 uses the following synchronization mechanisms to take account of the setting times for the various measuring components and to monitor device status:

- Using a register which indicates the states of the measuring components after settings
- Using commands which take account of settling processes.

4.3.6.1 Synchronization register

Register commands

Command	Meaning
:STAT:OPER:COND?;	Read out hardware status. If "0" is read, the device is ready
:STAT:OPER:EVEN?;	Read out transitions from "not ready" to "ready" which have occurred (Read out Event Register)
:STAT:OPER:ENAB?;	Query mask setting
:STAT:OPER:ENAB;	Set mask for transferring the states of the OPR register to the Status Byte.

OPR register assignments

Bit	Meaning	Explanation	
1	Measuring	"0"	No measurement (STOP)
		"1"	Measurement in progress (START)
2	No RX bit rate	"0"	External bit rate measurement stable
		"1"	External bit rate measurement not completed
3	No RX clock	"0"	Clock recovery stable
		"1"	Clock recovery not completed
4	No TX bit rate	"0"	TX bit rate measurement stable
		"1"	TX bit rate measurement not completed

Note: The bits indicate the status after a device setting is made. Only the internal setting times are monitored as a result. These bits cannot be used for monitoring purposes, e.g. checking the validity of the external bit rate.

4.3.6.2 Synchronization commands

The SF-60 recognizes the synchronization commands *WAI, *OPC? and *OPC.

All have the same effect, which is however indicated differently.

As a rule, the device waits until the status of the OPR Condition Register is "0".

*WAI

Example	Meaning
:PRESET$_U$2048; *WAI; :START;	Waits until the OPR register = 0, then processes next command Set Wait Start measurement

*OPC?

Example	Meaning
:PRESET$_U$2048; *OPC?; :START;	Also sets a "1" in the SF-60 output buffer. The user knows that the internal setting procedures are complete when this "1" is read out. Set Read output buffer Start measurement

*OPC

Example	Meaning
*ESE$_U$1; *SRE$_U$32; :PRESET$_U$2048; *OPC; <wait for RQS> :START;	Sets the OPC bit in the Standard Event Status Register ESR. Useful only in conjunction with RQS, i.e. the masks for the OPC and ESB bit in the status byte must be set. Enable masks Set Set OPC bit Wait until RQS bit is set Start measurement

4.3.7 Initialization

4.3.7.1 Power-on behavior

The initialization type depends on the following situations:

Situation 1: RAM test detects error or
SF-60 is switched on with CLR key held down

Procedure	Corresponds to command
Sets measurement components to PRESET 139 Mbit/s	
Sets Power On Status Clear Flag	*PSC$_U$1;
Sets result mask	:RSLT:MASK$_U$STATUS;
Clears register block	*CLS;
Sets Event Enable Register Masks	*SRE$_U$0; *ESE$_U$0; :STAT:DEV:ENAB$_U$0; :STAT:OPER:ENAB$_U$0;
Clears alarm output queue	
Clears data output queue	
Clears error buffer	
Sets ESR register bit 7 PON	
Sets DEV register bit 1 Data Loss	

Situation 2: RAM test o.k., CLR key not held down and Power On Status Clear Flag set.

Procedure	Corresponds to command
Measurement component settings remain as before	
Sets result mask	:RSLT:MASK$_U$STATUS;
Clears register block	*CLS;
Sets Event Enable Register Masks	*SRE$_U$0; *ESE$_U$0; :STAT:DEV:ENAB$_U$0; :STAT:OPER:ENAB$_U$0;
Clears alarm output queue	
Clears data output queue	
Clears error buffer	
Sets ESR register bit 7 PON	

Situation 3: RAM test o.k., CLR key not held down and Power On Status Clear Flag cleared.

Procedure	Corresponds to command
Measurement component settings remain as before	-
Sets ESR register bit 7 PON	-

Note for GPIB: The SF-60 must receive the PPC sequence (MLA, PPC, PPE, UNL) after power on if it is to respond to a parallel poll (ATN & EOI). See also section 4.3.3 "Common Commands"; Individual status query (*IST?).
This status can additionally be queried on the GPIB with a parallel poll (ATN and EOI active simultaneously). The bit to be activated must be specified to the SF-60 after each power on.

– Configuration sequence:
– Address SF-60 as listener
– Transmit PPC (5) command
– Transmit PPE (011 xyyy) command
  x = 1: set bit when "ist" = 1
  x = 0: set bit when "ist" = 0
  yyy = bit position
  yyy = 000 --> bit position 2^0 - de-address

4.3.7.2 GPIB initialization

Initialization takes place in three stages:

Command required		Process
Stage 1:	IFC line	GPIB hardware initialized
Stage 2:	GPIB commands DCI or SDC (4hex,14hex) :RSLT:MASK$_U$STATUS;	Remote control section initialized Sets result mask Clears alarm output queue Clears data output queue
Stage 3:	*RST; or *CLS;	Device initialization

4.3.7.3 RS-232 initialization

Initialization takes place in two stages:

Command required		Process
Stage 1:	(All zeros for length of 2 characters) :RSLT:MASK$_U$STATUS;	Remote control section initialized Sets result mask Clears alarm output queue Clears data output queue
Stage 2:	*RST; or *CLS;	Device initialization

Note: Common commands "*CLS;" and "*RST;" (see section 4.3.3 "Common commands"):

Command	Meaning
*CLS;	Clears all previous information stored in the register structures (error buffer, alarm queue, ESR register, OPR register, DEV register). The masks set for the registers are not altered.
*RST;	Includes all the initializations performed by *CLS; and sets the measurement section to 138264 Mbit/s.

4.3.8 Reference list of commands related to software versions

Device-specific program commands (compound commands)

Syntax	Altered in software version:	Query	Summary
:ALARM:ACT?;		-	Output actual alarm status
	3.x		further alarm numbers added
:ALARM:QUE?;		-	Output alarm queue
	3.x		further alarm numbers added
:ALARM:PAST?;		-	Output alarm monitor (option)
	3.x		further alarm numbers added
:AMA:CFG < >;		yes	Start autoconfiguration (CCITT / PMP)
:AMA:FPP < >;		yes	Function check program on / off
:BEEP < >;		yes	Beeper setting
:CLR:STO_EV;		no	Clear event monitor alarm memory
	3.x		Command must not be used
:CNTR:C1 < >;		yes	Measurement channel assignment: Counter 1
:CNTR:C2 < >;		yes	Measurement channel assignment: Counter 2
:CNTR:C3 < >;		yes	Measurement channel assignment: Counter 3
:DATE < >;		yes	Enter actual date
:DISP:RESULT < >;		no	Display results on monitor
	2.x		must be replaced with: DISP:MENU:NAME<>;
:DISP:MENU:NAME < >;		-yes	Select menu for display
:DISP:ENAB < >;		-yes	Display ON/OFF
:ERR:BURST_NR < >;	-	yes	Burst / micro-interrupt duration (in kbit)
:ERR:BURST_TIME < >;	-	yes	Burst/micro-interrupt duration (in µsec)
:ERR:CME?;	-	-	Output command errors
:ERR:CODE < >;	-	yes	Code error insertion
:ERR:EXE?;	-	-	Output execution errors
:ERR:FNR_CYCLE < >;	-	yes	Repetition time (:ERR:GENERAT$_U$FRM_NR,...)
:ERR:FREQ < >;	-	yes	Error generation frequency (:ERR:GENERAT...)
:ERR:GENERAT < >;	-	yes	Error generation
:ERR:INS < >;	-	yes	Error insertion on / off
:ERR:MF:MASK < >;	-	yes	Multiframe (C-12 only; option)
:ERR:R_C_B < >;		yes	STM bit position (option)
	2.x	no	must be replaced with :ERR:R_C_MASK <>;
	3.x		compatible with :ERR:R_C_MASK <>;
:ERR:R_C_MASK <>;	-	yes	Position for STM byte (option)
:ERR:TYPE < >;		yes	Error type
	2.x		NDF compatible with AU_NDF
			STM_BIT must be replaced with STM_BYTE
	3.x		compatible with STM_BYTE/STM1_BYTE
			FAS compatible with FAS_2M ... FAS_STM1
:FPP:CYCLE < >;		yes	Function check program: Cycle control
:FPP:FUNCTION < >;		yes	Function check program: Sequence control
:FPP:TESTNR < >;		yes	Function check program: Start with test number
:FRAME < >;		yes	Frame structure on / off (option)
	3.x		only to be used with frame systems conforming to software version 2.x
			Must not be used for new application programs.

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:FRM:AIS < >;		yes	Frame with AIS on / off (option)
	3.x		compatible with:FRM:AIS_2Mbis:FRM:AIS_140M
:FRM:ALM < >;		yes	STM-1 alarms (option)
	2.x		FERF compatible with MS_FERF PAIS compatible with AU_AIS SAIS must be replaced with MS_AIS
	3.x		SAIS compatible with MS_AIS
:FRM:ALM_CYCLE < >;		yes	Alarm cycle (option)
:FRM:ALM_GEN < >;		yes	Alarm generation (option)
:FRM:AN < >;		yes	AN alarm bits (option)
	3.x		compatible with (depending on selected bit rate) :FRM:DN_PDH8M<>; and :FRM:DN_PDH34M<>;
		yes	
:FRM:CH:FREE < >;			Stuffing signal for non-selected tributaries (option)
	3.x		Parameter ONE no longer available ParameterZERO no longer available
:FRM:CH:RX < >;		yes	RX tributary channel (option)
	3.x		Command must not be used for new programs! compatible with :FRM:CH:RX_PDH2M :FRM:CH:RX_PDH8M :FRM:CH:RX_PDH34M :FRM:CH:RX_PDH140M :FRM:CH:RX_STM1C12 :FRM:CH:RX_STM1C3
:FRM:CH:TX < >;		yes	TX tributary channel (option)
	3.x		Command must not be used for new programs! compatible with :FRM:CH:TX_PDH2M :FRM:CH:TX_PDH8M :FRM:CH:TX_PDH34M :FRM:CH:TX_PDH140M :FRM:CH:TX_STM1C12 :FRM:CH:TX_STM1C3
:FRM:CONF < >;		yes	D.U.T. and frame configuration (option)
	3.x		Use only with frame system corresponding to software version 2.x Command must not be used for new programs!
:FRM:DNYY < >;	-	yes	DNYY alarm bits (option)
:FRM:DN_PDH8M<>;	-	yes	DN alarm bits for PCM 120
:FRM:DN_PDH34M<>;	-	yes	DN alarm bits for PCM 480
:FRM:OUT:RX < >;		yes	STM-1 output socket [54] (option)
	2.x		Parameter TRG compatible with FRM_TRIG
:FRM:PTR_EVAL < >;	-	yes	Activate TU-12 pointer evaluation (option)
:FRM:RX:SA_POS < >;	-	yes	S_a bit position in RX NFAS (option)
:FRM:SCAN_C12 < >;	-	yes	Automatic channel scan (option)
:FRM:SCR:RX < >;		yes	STM-1: RX scrambler (option)
	2.x		Parameter 7BIT compatible with ON Parameter 11BIT no longer available
:FRM:SCR:TX < >;		yes	STM-1: TX scrambler (option)
	2.x		Parameter 7BIT compatible with ON Parameter 11BIT no longer available

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:FRM:SYST < >;		yes	Frame system (option)
	2.x		STM1_VC4 compatible with STM1_C4
	3.x		PCM1920 compatible with :FRM_SYST:TX$_U$UNFRM_34M,140M; and :FRM_SYST:RX$_U$140M,UNFRM_34M; PCM480 compatible with :FRM_SYST:TX$_U$UNFRM_8M,34M; and :FRM_SYST:RX$_U$34M,UNFRM_8M; PCM120 compatible with :FRM_SYST:TX$_U$UNFRM_2M,8M; and :FRM_SYST:RX$_U$8M,UNFRM_2M; PCM30CRC compatible with :FRM_SYST:TX$_U$64K,2M; and :FRM_SYST:RX$_U$2M,64K; 2M_34M compatible with :FRM_SYST:TX$_U$UNFRM_2M,34M; and :FRM_SYST:RX$_U$34M,UNFRM_2M; STM1_C4 :FRM_SYST:TX$_U$UNFRM_140M,STM_C4; and :FRM_SYST:RX$_U$STM1_C4,UNFRM_140M; STM1_C12 compatible with :FRM_SYST:TX$_U$UNFRM_2M,STM_C12; and :FRM_SYST:RX$_U$STM1_C12,UNFRM_2M; Command must not be used for new programs!
:FRM_SYST:RX < >;		yes	Frame setting RX side
:FRM_SYST:TX < >;		yes	Frame setting TX side
:FRM:TRG:TX < >;		yes	STM-1: TX Frame trigger (option)
	2.x		Parameter EXT compatible with FRM_SYNC Parameter INT compatible with FRM_TRIG
:FRM:TRIB_OFFS < >;	-	yes	Tributary offset (option)
:FRM:TS16_PTN1 < >;	-	yes	Pattern in TS 16, frame 1 (option)
:FRM:TS16_PTN2 < >;	-	yes	Pattern in TS 16, frames 2 to 15 (option)
:FRM:TX:C12_MAP < >;	-	yes	STM-1 C-12 mapping (TX only)
:FRM:TX:NFAS < >;	-	yes	Not frame alignment signal (option)
:FRM:TX:SA_POS < >;	-	yes	S_a bit position in TX NFAS (option)
:FRM:TX:SA_PTN < >;	-	yes	Selected S_a bit pattern (option)
:FRM:TYPE:RX_PDH2M;	-		RX: set PCM 30/31
:FRM:TYPE:TX_PDH2M;	-		TX: set PCM 30/31
:FRM:VC12_POH < >;	-	yes	Pattern for VC12 POH V5 bits 4 to 8
:FRM:V11:RX < >;		yes	Read data from SOH/POH via [55] (option)
	2.x		compatible with :FRM_OH:R_C:RX < >;
:FRM:V11:TX < >;		yes	Load data from SOH/POH via [53] (option)
	2.x		must be replaced with:FRM_OH:R_C:TX < >;
	3.x		compatible with :FRM_OH:R_C:TX < >;
:FRM_OH:R_C:RSLT < >;	-	yes	Row/Column selection
:FRM_OH:R_C:RX < >;	-	yes	Output overhead viaV.11 [55] or evaluation
:FRM_OH:R_C:TX < >;	-	yes	Overhead generation
:FRM_OH:SEQ_HEX < >;	-	yes	64 byte sequence in hex code
:FRM_OH:SEQ_ASC < >;	-	yes	64 byte sequence in ASCII
:FRM_OH:SEQ_PATH < >;	-	yes	15 byte path trace in ASCII

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:G821:ACT?;	-	-	G.821 evaluation intermediate result
:G821:END?;	-	-	G.821 evaluation final result
:G821:AS_ES < >;	-	yes	Alarm seconds = SES evaluation on / off
:G821:MXDIV < >;	-	yes	G.821 MUX divider on / off
:G821:PERFM < >;		yes	Select events to be counted for G.821 evaluation
	2.x		Parameter FEBE compatible with HP_FEBE
	3.x		FASB compatible with: FASB_2M FASB_8M FASB_34M FASB_140M FASB_STM1 FASW compatible with: FASW_2M FASW_8M FASW_34M FASW_140M FASW_STM1
:G821:PRT:INT1 < >;	-	yes	Interval time for 1st intermediate printout
:G821:PRT:INT2 < >;	-	yes	Interval time for 2nd intermediate printout
:G821:PRT:INTV1 < >;	-	yes	1st intermediate printout on / off
:G821:PRT:INTV2 < >;	-	yes	2nd intermediate printout on / off
:G821:PRT:INTV3 < >;	-	yes	3rd intermediate printout on / off
:G821:THLD:DM < >;	-	yes	G.821 DM threshold
:G821:THLD:SES < >;	-	yes	G.821 SES threshold
:GATE:CYCLE < >;	-	yes	Measurement cycle setting
:GATE:INTV:TIME < >;	-	yes	Set measurement interval (time parameter)
:J:AMPL < >;	-	yes	Jitter amplitude (option)
:J:AUTO < >;	-	yes	Tolerance to jitter measurement (MTJ) on / off (option)
:J:FREQ < >;	-	yes	Jitter frequency (option)
:J:F_SELECT < >;	-	yes	Frequency values for :J:F_SOURCE EXT; (option)
:J:F_SOURCE < >;	-	yes	Frequency values internal / external defined by user
		yes	(option)
:J:F_START < >;	-	yes	Start frequency for MTJ measurement (option)
:J:F_STEP < >;	-	yes	Frequency steps/decade for MTJ measurement (option)
		yes	Stop frequency for MTJ measurement (option)
:J:F_STOP < >;	-	yes	Jitter modulation signal internal / external (option)
:J:MOD < >;	-	yes	Measurement delay for MTJ measurement (option)
:J:MTJ:DELAY < >;	-	yes	MTJ error source (option)
:J:MTJ:ERR_SRC < >;	-	yes	Error threshold for MTJ measurement (option)
:J:MTJ:THLD < >;	-	yes	Jitter on / off (option)
:J:TX < >;	-	yes	
:LANGUA;	-	yes	Select menu language (out of two possible languages)
:LOCK < >;	-	no	RS-232 setting: Enable / disable LOCAL key

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:MEM:DEL < >;		no	Delete device settings (setups)
	2.x		setups reduced to internal 10, external 110, 210
:MEM:NAME < >;		no	Edit setup name
	2.x		setups reduced to internal 10, external 110, 210
:MEM:PLIST < >;		no	Print stored device settings
	2.x		setups reduced to internal 10, external 110, 210
:MEM:RCL < >;		no	Recall a stored device setting
	2.x		setups reduced to internal 10, external 110, 210
:MEM:STO < >;		no	Store current device setting as setup
	2.x		setups reduced to internal 10, external 110, 210
:MODE < >;	-	yes	Transmitter / receiver coupling
:PANEL < >;	-	yes	Enable / disable control panel
:OHC:R_C_MASK < >;	-	yes	Overhead compare
:PASSWD < >;	-	no	Password for modem operation
:PRESET < >;	-	no	PRESET settings, unframed operation
:PRT:DEV< >;	-	yes	Select internal/external printer
:PRT:DRIVER< >;	-	yes	Select printer driver for external printer
:PRT:MODE < >;		yes	Printer operating mode
	2.x		DIAGR,FEBE compatible with DIAGR,HP_FEBE
	3.x		FASB compatible with
			FASB_2M
			FASB_8M
			FASB_34M
			FASB_140M
			FASB_STM1
			FASW compatible with
			FASW_2M
			FASW_8M
			FASW_34M
			FASW_140M
			FASW_STM1
:PRT:PANEL;	-	no	Print complete current device setting
:PRT:PRINT;	-	no	Print current device setting and results
:PRT:STO_EV;	-	no	Print stored events (alarm monitor)
:PRT:STOP;	-	no	Stop print (= STOP/PAPER key)
:PRT:THLD:COUNT < >;	-	yes	Threshold for error count
:PRT:THLD:INCR < >;	-	yes	Threshold for error increment
:PRT:THLD:RATIO < >;	-	yes	Threshold for error ratio
:PRT:THLD:TYPE < >;		yes	Counter selection for conditional printout
	2.x		FEBE compatible with HP_FEBE
:PRT:TRIGG < >;	-	yes	Printer trigger selection
:PRT:USERL1 < >;	-	yes	Header line 1
:PRT:USERL2 < >;	-	yes	Header line 2
:PRT:USERLINE < >;	-	yes	Print header on / off
:RAMC:COPY < >;		no	Copy stored device settings
	2.x		setups reduced to internal 10, external 110, 210
:RAMC:DEL < >;		no	Delete stored device settings
	2.x		setups reduced to internal 10, external 110, 210
:RAMC:FORMAT;	-	no	Format memory card
:RAMC:PDIR;	-	no	Printout of device settings (summary)

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:REMOTE < >;	-	no	RS-232 setting: Remote control on / off
:RIC < >;	-	yes	Ricar sequence toggle frequency
:RSLT:ACT?;		-	Output next intermediate result
:RSLT:CLEAR < >;		no	Clear result memory
	2.x		Parameter INT no longer available
	3.x		Command must not be used (no result storage)
:RSLT:DISP < >;		no	Result display internal / external
	2.x		Parameter INT no longer available
	3.x		Command must not be used (no result storage)
:RSLT:END?;		-	Output final result
:RSLT:EXT_MEM < >;		no	External result memory overwrite disabled
	3.x		Command must not be used (no result storage)
:RSLT:INT_MEM < >;		no	Internal result memory overwrite disabled
	2.x		Internal result memory no longer available
:RSLT:MASK < >;		yes	Data output mask
	2.x		STM_BYTE compatible with R_C_BYTE
			FEBEC muß ersetzt werden mit HP_FEBEC
	3.x		FEBEC compatible with HP_FEBEC
			FASWC compatible with FASWC_2M
			FASWC_8M
			FASWC_34M
			FASWC_140M
			FASWC_STM1
			FASWR compatible with FASWR_2M
			FASWR_8M
			FASWR_34M
			FASWR_140M
			FASWR_STM1
			DNYY compatible with DN_2M
			DN_8M
			DN_34M
			DN_140M
			DN_STM1
			STFR compatible with STFR_2M
			STFR_8M
			STFR_34M
			STFR_140M
			STFR_STM1
:RSLT:MASK?;		-	Query of data output mask
	2.x	-	altered corresponding to RM list
:RSLT:MTJ?;			MTJ result output (option)
:RSLT:NR < >;		no	Current result number
	3.x		Command must no longer be used (no result storage)
:RSLT:POH_R < >;		yes	POH position (option)
:RSLT:RECALL;		no	Calling current result number
	3.x		Command must no longer be used (no result storage)
:RSLT:SCROLL < >;		no	Scroll result pages
	3.x		Command must no longer be used (no result storage)
:RSLT:SOH_R_C < >;			SOH position (option)
:RSLT:STM_BYTE < >;		yes	Select SOH/ POH byte for data output (option)
:RSLT:STORED?;		yes	Result memory output
	3.x	-	Command must no longer be used (no result storage)
:RSLT:WORST < >;			Recall worst-case error result, longest or last alarm
	3.x	no	Command must no longer be used (no result storage)

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:RX:AUTO_LEV;		no	Automatic setting of input sensitivity
:RX:BITR < >;		yes	RX bit rate
:RX:CLK_SRC < >;		yes	RX clock source
:RX:CODE < >;		yes	RX code
:RX:DECOD < >;		yes	RX decoder behavior
:RX:EQ < >;		yes	Input equalizer
:RX:ERR_INP < >;		yes	External error input [49] sensitivity
:RX:ERR_OUT < >;		yes	Event trigger to output [48]
:RX:EVAL < >;		yes	Code error evaluation
:RX:LEVEL < >;		yes	Input level CCITT / PMP
:RX:NOM_AMPL < >;		yes	Nominal input signal level
:RX:PRS < >;		yes	RX pattern inversion
:RX:PTN < >;		yes	RX pattern
:RX:SLPE < >;		yes	RX clock edge positive / negative
:RX:THLD < >;		yes	RX signal sampling threshold
:SEQ:CYCLE < >;		yes	Automatic test sequence: Sequence cycle
:SEQ:RNG < >;		yes	Automatic test sequence: Sequence range
:SEQ:SWITCH < >;		yes	Automatic test sequence: Sequence switch on / off
:START;	-	no	Start measurement
:STAT:DEV:COND?;		-	Output DEV condition register
:STAT:DEV:EVEN?;		-	Output DEV event register
:STAT:DEV:ENAB?;		-	Output DEV event enable register
:STAT:DEV:ENAB < >;		yes	Set DEV event enable register
:STAT:EVEN:COND?;		-	Output ESR condition register
:STAT:OPER:COND?;		-	Output OPR condition register
:STAT:OPER:EVEN?;		-	Output OPR event register
:STAT:OPER:ENAB?;		-	Output OPR event enable register
:STAT:OPER:ENAB < >;		yes	Set OPR event enable register
:ST_DATE < >;		yes	Timer start date
:ST_EVENT < >;		yes	Start event manual / timer
:ST_TIME < >;		yes	Timer start time
:STOP;		no	Stop measurement
:THLD:MI < >;		yes	Micro-interrupt threshold
:THLD:NO_SIG < >;		yes	NO SIGNAL detection threshold
:TIME < >;		yes	Set actual time
:TX:AIS_PTN < >;		yes	TX pattern with AIS
:TX:AMPL < >;		yes	TX signal amplitude
:TX:BITR < >;		yes	TX bit rate
:TX:CLK_SRC < >;		yes	TX clock source
:TX:CODE < >;		yes	TX code
:TX:ERR_INP < >;		yes	Control input [43] sensitivity
:TX:LASER < >;		yes	TX laser source on / off (option)
:TX:OFFS < >;		yes	TX signal offset
:TX:PRS < >;		yes	TX pattern inversion
:TX:PTN < >;		yes	TX pattern

Device-specific program commands (compound commands) (continued)

Syntax	Altered in software version:	Query	Summary
:V24:BAUDR < >;	-	yes	RS-232 interface: Baud rate
:V24:DATA < >;	-	yes	RS-232 interface: Number of data bits
:V24:DEV < >;	-	yes	RS-232 interface: Operating mode modem / PC / printer
:V24:HANDSH < >;	-	yes	RS-232 interface: Handshake hardware / software
:V24:PARITY < >;	-	yes	RS-232 interface: Parity
:V24:PASSWD < >;	-	yes	RS-232 interface: Password entry
:V24:STOP < >;	-	yes	RS-232 interface: Number of stop bits

Common commands

Syntax Altered in software version:	Query	Summary
*CLS;	no	Clear Status Command (part-initialization)
*DDT < >;	yes	Define Device Trigger Command
*DDT?;	-	Define Device Trigger Query
*ESE < >;	yes	Standard Event Status Enable Command
*ESE?;	-	Standard Event Status Enable Query
*ESR?;	-	Standard Event Status Register Query
*IDN?;	-	Identification Query
*IST?;	-	Individual Status Query ("ist" sum bit)
*LRN?;	-	Learn Device Setup Query
Note:		Current device setups are not series-upwards compatible
*OPC;	yes	Operation Complete Command
*OPC?;	-	Operation Complete Query
*OPT?;	-	Option Identification Query
*PCB < >;	no	Pass Control Back
*PRE < >;	yes	Parallel Poll Enable Register Enable Command
*PRE?;	-	Parallel Poll Enable Register Enable Query
*PSC < >;	yes	Power-On Status Clear Command
*PSC?;	-	Power-On Status Clear Query
*RST;	no	Reset Command
*SRE < >;	yes	Service Request Enable Command
*SRE?;	-	Service Request Enable Query
*STB?;	-	Read Status Byte Query
*TRG;	no	Trigger Command
*TST?;	-	Self Test Query
*WAI;	no	Wait-to-Continue Command

4.4 Programming with the LabWindows/CVI driver for SF-60

Integrating test equipment into automatic test systems can be very time-consuming if each GPIB command has to be programmed individually.

LabWindows/CVI is an increasingly popular software development platform for data acquisition and remote control of instrumentation. Wandel & Goltermann supplies LabWindows drivers for several instruments, including the SF-60.

Using the Wandel & Goltermann LabWindows driver, you can set the instrument or query results simply by clicking the appropriate item. The function is then copied into your application program as you create it.

The LabWindows driver allows the SF-60 to be remote controlled via the RS 232 interface as well as the GPIB interface.

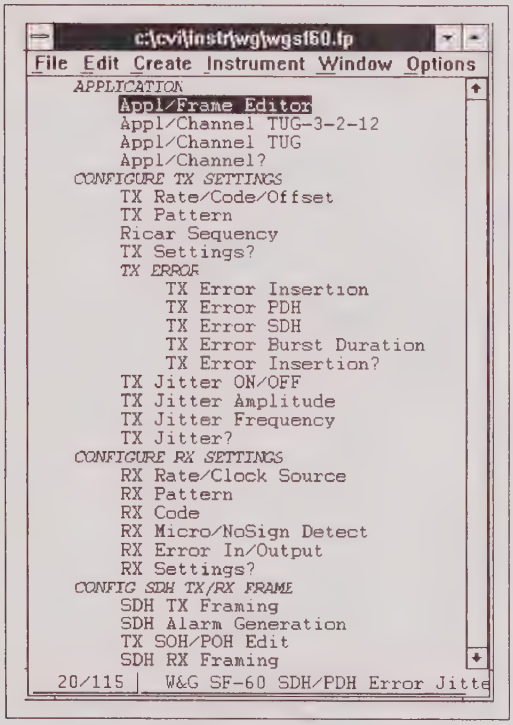


Fig. 4-28 SF-60 LabWindows driver example

The LabWindows driver for the SF-60 is available under order number **BN 3017/95.99**.

4.5 Program examples for RS-232 and GPIB remote control

The following examples demonstrate the appearance of small applications for the SF-60 in C programming language.

They are intended as an aid to getting started with the SF-60 and to simplify its use. Special features of C have been avoided in order to simplify conversion to othe programming languages.

Turbo C 2.0 was used as compiler. The names of the modules used and which are to be included in the relevant project files are contained in the control program.

4.5.1 Measuring the system tolerance to jitter

```
/*****************************************************************/
/*     Wandel & Goltermann                                       */
/*     SF-60 controlled via RS 232 / IEEE bus                    */
/*****************************************************************/
/*                                                               */
/*     File:                      mtj.c                          */
/*                                                               */
/*     Matching to Turbo C 2.0                                   */
/*     The following modules are required:                       */
/*     Project file:                                             */
/*             mtj.c                                             */
/*             shell.c                                           */
/*             module.c       Shell for device driver            */
/*                            serial.sys                         */
/*             modu_iec.c     Shell for device driver            */
/*                            gpib.com                           */
/*             tcibs.obj                                         */
/*                                                               */
/*     Application:                                              */
/*     Measuring the system tolerance to jitter                  */
/*                                                               */
/*     Requirements:                                             */
/*     RS232          Driver serial.sys loaded                   */
/*                    DEVICE=serial.sys /0 /SF60                 */
/*     IECBUS         National Instruments board                 */
/*                    DEVICE=gpib.com                            */
/*****************************************************************/
/*     copyright      W&G                                        */
/*****************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include "protos.h"
/*****************************************************************/
/* Internal function prototypes                                  */

void      info(void );
void      appl(void );
/*****************************************************************/
/* Global variables                                              */

/*****************************************************************/
/* Select interface                                              */
char          interface[2] = "V";     /* I = Ieeebus,  V = V24   */
/*****************************************************************/
/* Initial settings for IEEE bus operation                       */
char          iecdevice[8] = "DEV1";     /*                     */
int           iecbusadr = 1;             /* SF-60 address       */
```

```
/*****************************************************************/
/* Initial settings for V24 operation                            */

char          devicename[9] = "SF60";   /* Driver name          */
char          devicetyp[2] = "M";       /* P == PC, M == Modem  */
char          baudrate[5] = "9600";     /*300,600,1200,2400,9600*/
char          databits[2] = "8";        /* 7 or 8               */
char          stopbits[2] = "1";        /* 1 or 2               */
char          parity[2] = "N";          /* No, Even, Odd        */
char          handshake[2] = "S";       /* Software, Hardware   */

int          exit_timeout = 1;          /* Abort program when
                                           timeout occurs.
                                           When setting to FALSE,
                                           the retcode of the
                                           driver functions must
                                           always be evaluated
                                        */
/*****************************************************************/
/* Initial device settings                                       */

char    cmd1[] =
        "*RST;*CLS;:STAT:OPR:ENAB 0; DEV:ENAB 0; *SRE 0; *ESE 0;";

void    main(void)
{
int     i,retc;
int     opr;
char    buffer[1000];
    clrscr();
    fprintf(stdout,"\n*****************************************
                                                    **************\n");

/*****************************************************************/
/* Set interface                                                 */

    if ( schnittstelle[0] == 'I' || schnittstelle[0] == 'i')
    {
         fprintf(stdout,"SF-60 control via IEEE bus\n");
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Device: <%s> ",iecdevice);
         fprintf(stdout,"Address: <%2d> \n",iecbusadr);

         init_iec();
    }
    else
    {
         fprintf(stdout,"SF-60 control via RS 232\n");
         initialize();
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Driver: <%s> ",devicename);
         fprintf(stdout,"Type: <%s> ",devicetyp);
         fprintf(stdout,"Baud: <%s> ",baudrate);
         fprintf(stdout,"Data: <%s> ",databits);
         fprintf(stdout,"Stop: <%s> ",stopbits);
         fprintf(stdout,"Pary: <%s> ",parity);
         fprintf(stdout,"Handsh: <%s>\n\n",handshake);
    }
    fprintf(stdout,"\n***********************************");
    fprintf(stdout,"***********************************\n");

    set_timo(30);                          /* Set timeout      */
```

```
    /*************************************************************/
    /* Preset device                                             */

    retc = print(cmd1);          /* Clear status register        */
    if (retc )                   /* Evaluate return code         */
    {                            /* for exit_timeout = FALSE     */
         fprintf(stderr,"Transmission error.\n");
         exit(1);
    }

/*****************************************************************/
    info();                 /* Display measurement sequence      */
    appl();                 /* Execute measurement               */

/*****************************************************************/
/* End program                                                   */
    end_v24();
}


/*****************************************************************/
void     info(void)
{
  printf("* * * * * * * * * * * * * * * * * * * * * * * * * * * *\n");
  printf("*   Test program     SF-60 MTJ measurement              *\n");
  printf("*                                                       *\n");
  printf("*   Sequence:                                           *\n");
  printf("*        - Set MTJ measurement                          *\n");
  printf("*                                                       *\n");
  printf("*        - Read in results until measurement            *\n");
  printf("*          completed                                    *\n");
  printf("* * * * * * * * * * * * * * * * * * * * * * * * * * * *\n");
}
/*****************************************************************/
void     mtj_set()
{
    print(":preset 139264;");
    print(":j:f_start 100; f_stop 1000; f_step 2;");
    print(":j:auto mtj; ");
    print(":prt:trigg man; :start;");
}
```

```
/*****************************************************************/
void     appl(void)
{
char     buffer[1000];
char     last[100];
unsigned int     time, no;
int     stat;
    mtj_set();                    /* Set SF-60 for measurement  */
    print(":err:exe?; cme?;");    /* Check error status         */
    input(buffer);
    if ( ! strncmp(buffer,"0,\"\";0,\"\";",10))
    {
         printf("Fehlerstatus: %s\n",buffer);
         exit(1);
    }
    /*****************************/
    while (1)
    {
         print(":rslt:mtj?;");    /* Read in measurement result */
         input(buffer);
         printf("Measurement result: %s\n",buffer);
         print(":stat:oper:cond?;"); /* Device still measuring? */
         input(buffer);
         stat=atoi(buffer);
         stat &= 0x01;               /* Extract busy bit        */
         if ( stat == 0)
         {
             printf(" Measurement ended \n");
             break;
         }
    }
}
```

4.5.2 Reading and storing device setups

```
/*****************************************************************/
/*       Wandel & Goltermann                                     */
/*       SF-60 controlled via RS 232 / IEEE BUS                  */
/*****************************************************************/
/*                                                               */
/*       File:                          setup.c                  */
/*                                                               */
/*       Matching to Turbo C 2.0                                 */
/*       The following modules are required:                     */
/*       Project file:                                           */
/*               setup.c                                         */
/*               schale.c                                        */
/*               module.c      Shell for device driver           */
/*                             serial.sys                        */
/*               modu_iec.c    Shell for device driver           */
/*                             gpib.com                          */
/*               tcibs.obj                                       */
/*                                                               */
/*       Application:                                            */
/*                                                               */
/*       Reads all setups stored in instrument and stores        */
/*       setups to mass memory or vice versa.                    */
/*       Interface can be selected.                              */
/*                                                               */
/*       Requirements:                                           */
/*       RS232           Driver serial.sys loaded                */
/*                       DEVICE=serial.sys /0 /SF60              */
/*       IECBUS          National Instruments board              */
/*                       DEVICE=gpib.com                         */
/*****************************************************************/
/*       copyright       W&G                                     */
/*****************************************************************/

#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include "protos.h"

/*****************************************************************/
/* Internal function prototypes                                  */

void     main(int anz, char *args[]);
void     read_set1(int   adr);
void     send_set1(int   adr);
```

```
/*****************************************************************/
/* Global variables                                              */

/*****************************************************************/
/* Selecting the interface                                       */

char          interface[2] = "V";       /* I = Ieeebus,  V = V24 */

/*****************************************************************/
/* Initial settings for IEEEBUS operation                        */

char          ieeedevice[8] = "DEV1";   /*                       */
int           ieeebusadr = 1;           /* SF-60 address         */

/*****************************************************************/
/* Initial settings for V24 operation                            */

char          devicename[9] = "SF60";   /* Driver name           */
char          devicetyp[2] = "M";       /* P == PC, M == Modem   */
char          baudrate[5] = "9600";     /*300,600,1200,2400,9600 */
char          databits[2] = "8";        /* 7 or 8                */
char          stopbits[2] = "1";        /* 1 or 2                */
char          parity[2] = "N";          /* No, Even, Odd         */
char          handshake[2] = "S";       /* Software, Hardware    */


int          exit_timeout = 1;          /* Abort program when
                                           timeout occurs.
                                           When setting to FALSE,
                                           the retcode of the
                                           driver functions must
                                           always be evaluated
                                                                 */
/*****************************************************************/
/* Initial device settings                                       */

char    cmdl[] =
        "*RST;*CLS;:STAT:OPR:ENAB 0; DEV:ENAB 0; *SRE 0; *ESE 0;";

void    main(int anz, char *args[])
{
int     i,retc;
char    par2[]="/STORE";
char    par1[]="/RESTORE";
char    buffer[1000];
char    b2[1000];
    clrscr();
    fprintf(stdout,"\n*********************************************
                                          *************************\n");
```

```
/*****************************************************************/
/* Check parameters                                              */
    if(! (anz == 2))
    {
    fprintf(stdout,"\nCall");
    fprintf(stdout,"\n       - %s  %s ",args[0],par2);
    fprintf(stdout,"\n         to read setups from SF-60\n");
    fprintf(stdout,"\n       - %s  %s ",args[0],par1);
    fprintf(stdout,"\n         to send setups to SF-60\n");
    exit(1);
    }
    strupr(args[1]);
    if( strncmp(args[1],par1,4) && strncmp(args[1],par2,4))
    {
    fprintf(stdout,"\a\nWrong parameter < %s >",args[1]);
    fprintf(stdout,"\nCall:");
    fprintf(stdout,"\n       - %s  %s ",args[0],par1);
    fprintf(stdout,"\n       - %s  %s ",args[0],par2);
    exit(2);
    }
/*****************************************************************/
/* Set interface                                                 */


    if ( interface[0] == 'I' || interface[0] == 'i')
    {
         fprintf(stdout,"SF-60 control via IEEE bus\n");
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Device: <%s> ",ieeedevice);
         fprintf(stdout,"Address: <%2d> \n",ieeebusadr);

         init_iec();
    }
    else
    {
         fprintf(stdout,"SF-60 control via RS 232\n");
         initialize();
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Driver: <%s> ",devicename);
         fprintf(stdout,"Type: <%s> ",devicetyp);
         fprintf(stdout,"Baud: <%s> ",baudrate);
         fprintf(stdout,"Data: <%s> ",databits);
         fprintf(stdout,"Stop: <%s> ",stopbits);
         fprintf(stdout,"Pary: <%s> ",parity);
         fprintf(stdout,"Handsh: <%s>\n\n",handshake);
    }
    fprintf(stdout,"\n***********************************");
    fprintf(stdout,"***********************************\n");

    set_timo(30);                          /* Set timeout      */
```

```
    /*****************************************************************/
    /* Preset device                                                 */

    retc = print(cmd1);          /* Clear status register        */
    if (retc )                   /* Evaluate return code         */
    {                            /* for exit_timeout = FALSE     */
         fprintf(stderr,"Transmission error.\n");
         exit(1);
    }

/*****************************************************************/
/* Read in setups                                                */

    if( ! strncmp(args[1],par2,4) )
    {
         fprintf(stdout,"Read setups from SF-60\n\n");
         read_set1(1);          /* Readout of device setups      */
         read_set1(101);        /* Readout of RAMcard            */
         read_set1(201);        /* Readout of RAMcard            */
    }
/*****************************************************************/
/* Transmit setups                                               */
    if( ! strncmp(args[1],par1,4) )
    {
         fprintf(stdout,"Re-assign setups in SF-60\n\n");
         send_set1(1);          /* Device setups                 */
         send_set1(101);        /* RAMcard                       */
         send_set1(201);        /* RAMcard                       */
    }
/*****************************************************************/
/* End program                                                   */
         end_v24();
}
```

```
/*****************************************************************/
/* Transmit setups from diskette to device                       */

void send_set1(int    adr)
{
FILE    *file;
char    name[20], command[30], tmp[100], lrn[1100];
int     i,j,len,c;

    print("*cls;");
    for(i=adr;i<adr+20;i++)
    {   /* Read the 20 stored setups */
        /******** Read learn string from file ********************/
        strcpy(name,"setup");
        strcat(name,itoa(i,tmp,10));
        strcat(name,".lrn");

        if ((file = fopen(name,"r+b")) == 0)
        {
              continue;
        }

        for(j=0;(c=getc(file)) != EOF; j++)
        {
              lrn[j]=c;
        }
        lrn[j]='\0';
        fclose(file);

        /********* Transmit learn string ************************/
        print(lrn);
        print(":err:exe?; cmd?;");        /* Query error status of
                                             device */
        input(lrn);
        if (strncmp(lrn,"0,\"\";0,",7))
        {
           fprintf(stdout,"%s No correct learn string included\n",name);
           fprintf(stdout,"%s\n",lrn);
           continue;
        }
        /********* Store device setting *************************/
        strcpy(command,":MEM:DEL ");
        strcat(command,itoa(i,tmp,10));
        strcat(command,";");
        print(command);

        strcpy(command,":MEM:STO ");
        strcat(command,itoa(i,tmp,10));
        strcat(command,";");
        print(command);
        print(":err:exe?;");              /* Query error status of
                                             device */
        input(lrn);
        if (!strncmp(lrn,"181,",4))
        {
           fprintf(stdout,"RAMcard not fitted \n");
           break;
        }
        fprintf(stdout,"%s in Setup %3d abgelegt.\n",name,i);
    }/* end for */
}
```

```
/*****************************************************************/
/* Write setups from device to tape cassette                     */

void read_set1(int   adr)
{
FILE   *file;
char   name[20], command[30], tmp[100], lrn[1100];
int    i,j,len;
    print("*cls;");
    for(i=adr;i<adr+20;i++)
    {   /* Read the 20 stored setups */
    /********** Set setup ***************************************/
    strcpy(command,":MEM:RCL ");
    strcat(command,itoa(i,tmp,10));
    strcat(command,";");
    print(command);
    /********* Check setup **************************************/
    print(":err:exe?;");    /* Query error status of device     */
    input(lrn);
    if (strncmp(lrn,"0,\"\"",4))
    {
         fprintf(stdout,"Setup %3d error message: <%s>\n",i,lrn);
         if (!strncmp(lrn,"181,",4))
         {
           fprintf(stdout,"RAMcard not fitted \n");
           break;
         }
         continue;
    }

    /******** Read learn string *********************************/
    print("*lrn?;");
    input(lrn);
    if ((len=strlen(lrn)) != 1046)
    {
         fprintf(stderr,"Incorrect learn string length %4d \n",len);
         continue;
    }
    /******** Store learn string ********************************/
    strcpy(name,"setup");
    strcat(name,itoa(i,tmp,10));
    strcat(name,".lrn");

    if ((file = fopen(name,"w+b")) == 0)
    {
          fprintf(stderr,"Cannot open file %s\n",name);
          continue;
    }
    fprintf(stdout,"Store setup %3d in %s\n",i,name);
    j= fprintf(file,"%s",lrn);
    if ( j != len )
    {
         fprintf(stderr,"Cannot write to file %s\n",name);
         fclose(file);
         continue;
    }
    fclose(file);
    }/* end for */
}
/*****************************************************************/
```

4.5.3 Performing a repetitive bit error ratio measurement

```
/*****************************************************************/
/*     Wandel & Goltermann                                       */
/*     SF-60 controlled via RS 232 / IEEE bus                    */
/*****************************************************************/
/*                                                               */
/*     File:                      repbit.c                       */
/*                                                               */
/*     Matching to Turbo C 2.0                                   */
/*     The following modules are required:                       */
/*     Project file:                                             */
/*             repbit.c                                          */
/*             shell.c                                           */
/*             module.c           Shell for device driver        */
/*                                serial.sys                     */
/*             modu_iec.c         Shell for device driver        */
/*                                gpib.com                       */
/*             tcibs.obj                                         */
/*                                                               */
/*     Application:                                              */
/*     Controlling a repetitive bit error ratio measurement      */
/*                                                               */
/*     Requirements:                                             */
/*     RS232          Driver serial.sys loaded                   */
/*                    DEVICE=serial.sys /0 /SF60                 */
/*     IECBUS         National Instruments board                 */
/*                    DEVICE=gpib.com                            */
/*****************************************************************/
/*     copyright      W&G                                        */
/*****************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include "protos.h"
```

```
/*****************************************************************/
/* Global variables                                              */

/*****************************************************************/
/* Select interface                                              */

char          interface[2] = "V";       /* I = Ieeebus,  V = V24 */
/*****************************************************************/
/* Initial settings for IEEE bus operation                       */

char          iecdevice[8] = "DEV1";    /*                       */
int           iecbusadr = 1;            /* SF-60 address         */
/*****************************************************************/
/* Initial settings for V24 operation                            */

char          devicename[9] = "SF60";   /* Driver name           */
char          devicetyp[2] = "M";       /* P == PC, M == Modem   */
char          baudrate[5] = "9600";     /*300,600,1200,2400,9600 */
char          databits[2] = "8";        /* 7 or 8                */
char          stopbits[2] = "1";        /* 1 or 2                */
char          parity[2] = "N";          /* No, Even, Odd         */
char          handshake[2] = "S";       /* Software, Hardware    */

int           exit_timeout = 1;         /* Abort program when
                                           timeout occurs.
                                           When setting to FALSE,
                                           the retcode of the
                                           driver functions must
                                           always be evaluated
                                                                 */
```

```
/*****************************************************************/
/* Initial device settings                                       */

char    cmd1[] =
        "*RST;*CLS;:STAT:OPR:ENAB 0; DEV:ENAB 0; *SRE 0; *ESE 0;";

void    main(void)
{
int     i,retc;
int     opr;
char    buffer[1000];
    clrscr();
    fprintf(stdout,"\n*********************************************
                                          ***************************\n");

/*****************************************************************/
/* Set interface                                                 */

    if ( interface[0] == 'I' || interface[0] == 'i')
    {
         fprintf(stdout,"SF-60 control via IEEE bus\n");
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Device: <%s> ",iecdevice);
         fprintf(stdout,"Address: <%2d> \n",iecbusadr);

         init_iec();
    }
    else
    {

         fprintf(stdout,"SF-60 control via RS 232\n");
         initialize();
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Driver: <%s> ",devicename);
         fprintf(stdout,"Type: <%s> ",devicetyp);
         fprintf(stdout,"Baud: <%s> ",baudrate);
         fprintf(stdout,"Data: <%s> ",databits);
         fprintf(stdout,"Stop: <%s> ",stopbits);
         fprintf(stdout,"Pary: <%s> ",parity);
         fprintf(stdout,"Handsh: <%s>\n\n",handshake);
    }
    fprintf(stdout,"\n************************************");
                                              ******************\n");

    set_timo(30);                          /* Set timeout      */
```

```
    /*************************************************************/
    /* Preset device                                             */

    retc = print(cmd1);          /* Clear status register        */
    if (retc )                   /* Evaluate return code         */
    {                            /* for exit_timeout = FALSE     */
         fprintf(stderr,"Transmission error.\n");
         exit(1);
    }

/*****************************************************************/
    fprintf(stdout,"\nProgram for control of a RepN measurement \n");

    /* Set device hardware */
    print(":preset 139264; :tx:bitr 100e3;");
    print(":gate:cycle rep,4; intv:time ss,\"5.0\";");
    print(":err:ratio int_rat,1e-3; ins on;");

    /* Wait until device settings complete                       */
    /*      "*wai;"    Synchronization in device                 */
    /*      "*opc?;"   Synchronization from device output        */
    /*      "*opc;"    Synchronization using SRQ; the mask
                       registers must be set first:
                       "*ese 1; *sre 32;"                        */
    print("*ese 1; *sre 32; *opc;");
    retc=waitsrq();              /* Read "1" from device         */
    if (retc == -1)
    {
        printf("Program aborted as no RQS received\n");
        exit(1);
    }
    print("*stb?; *esr?;");       /* Evaluate event register     */
    input(buffer);               /* and clear                    */


    /* Set result mask                                           */
    print("rslt:mask status,repi,bec;");
    printf("Mask: ");
    printf("STATUS,REPI,BIT ERROR\n");

    /* Start device and read final results                       */

    print(":start;");
    while (1)
    {
        print(":rslt:end?");      /* Wait for result             */
        input(buffer);            /* Read resultsesen            */
        fprintf(stdout,"Results: %s\n",buffer);
        print(":stat:oper:even?");/* Test if measurement ended */
        input(buffer);
        opr=atoi(buffer);       /* Convert status                */
        if (opr & 1)
            break;              /* Break when measurement ended */
        if (kbhit())
            break;              /* Aborted by user              */
    }

/*****************************************************************/
/* End program                                                   */
        end_v24();
}
```

4.5.4 Bit error measurement at 100 Mbit/s

```
/*****************************************************************/
/*       Wandel & Goltermann                                     */
/*       Controlling the SF-60 via the RS 232 interface          */
/*****************************************************************/
/*       File:                 biterr.c                          */
/*                                                               */
/*       Matched to Turbo C 2.0                                  */
/*       The following modules are required:                     */
/*             biterr.c                                          */
/*             module.c      Sub-functions                       */
/*             module.h      Sub-function includes               */
/*             protos.h      Sub-function prototypes             */
/*                                                               */
/*       Application:                                            */
/*       Bit error measurement at 100 Mbit, showing the use      */
/*       of the device driver serial.sys.                        */
/*       IEEE bus operation is identical.                        */
/*                                                               */
/*       copyright       W&G                                     */
/*****************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include "protos.h"

/*****************************************************************/
/* Global variables                                              */

/* Initial settings of device driver and SF-60                   */

char       devicename[9] = "SF60";    /* Name des Treibers       */
char       devicetyp[2] = "M";        /* P == PC, M == Modem     */
char       baudrate[5] = "9600";      /* 300,600,1200,2400,9600  */
char       databits[2] = "8";         /* 7 or 8                  */
char       stopbits[2] = "2";         /* 1 or 2                  */
char       parity[2] = "N";           /* NO, EVEN, ODD           */
char       handshake[2] = "S";        /* Software, Hardware      */

int       exit_timeout = 1;           /* Abort program when
                                         timeout occurs.
                                         When setting to FALSE,
                                         the retcode of the
                                         driver functions must
                                         always be evaluated.
                                      */
```

```
/*****************************************************************/
/* Device setting data                                           */
/* Bit error measurement                                         */
char     cmd1[] = ":PRESET 139264; :TX:BITR 10E6;";
char     cmd2[] = ":ERR:GENERAT INT_RAT,1E-4; INS ON;";
char     cmd3[] = ":GATE:INTV:TIME SS,\"5.0\"";

void     main(void)
{
int      retc;
char     buffer[1000];
         clrscr();
/*****************************************************************/
/* Set interface                                                 */
         initialize();
/*****************************************************************/
         fprintf(stdout,"SF-60 control via RS 232\n");
         fprintf(stdout,"\Settings \n");
         fprintf(stdout,"Driver: <%s> ",devicename);
         fprintf(stdout,"Type: <%s> ",devicetyp);
         fprintf(stdout,"Baud: <%s> ",baudrate);
         fprintf(stdout,"Data: <%s> ",databits);
         fprintf(stdout,"Stop: <%s> ",stopbits);
         fprintf(stdout,"Pary: <%s> ",parity);
         fprintf(stdout,"Handsh: <%s>\n\n",handshake);
         fprintf(stdout,"\n************************************
                                          **********************\n");
/*****************************************************************/
/* Preset device                                                 */
/*****************************************************************/
         set_timov24(30);           /* Timeout in seconds       */
         retc = print_v24(cmd1);    /* Set device               */
         if (retc )                 /* Evaluate return code     */
                                    /* for exit_timeout = FALSE */
         printf("Transmission error.\n");
         print_v24(cmd2);
         print_v24(cmd3);
         print_v24(":RSLT:MASK BEC;");    /* Set result mask    */
         print_v24(":err:cme?; exe?;");   /* Query device error
                                             status */
         input_v24(buffer);               /* After query always
                                             read out response  */
         if (strncmp(buffer,"0,\"\";0,",6))
         {
             printf("Fehlerstatus: %s\n",buffer); /* Evaluate
                                                     error status */
             exit(1);
         }
/*****************************************************************/
/* Start measurement and wait for final result                   */
         printf("\n*********** Measurement 1 **************\n");
         print_v24("*WAI; :START;");  /* Wait for settling time,
                                         start device          */
         print_v24(":RSLT:END?;");    /* Query for result      */
         printf("Waiting for final result.\n");
         input_v24(buffer);           /* Timeout must be set
                                         longer than gate time  */
         printf("Measurement result: %s\n",buffer);
```

```
/*****************************************************************/
/* New measurement with wait for SRQ                             */
/* Erase previous results and set mask so that SF-60 sets SRQ
   at end of measurement.                                        */

        printf("\n********** Measurement 2 **************\n");
        print_v24("*CLS;:STAT:OPR:ENAB 1; *SRE 128; :START;");
        waitsrq_v24();
        print_v24(":STAT:OPR:EVNT?;");  /* Query SRQ cause     */
        input_v24(buffer);
        printf("Operation register: %s\n",buffer);

        print_v24(":RSLT:END?;");       /* Query for result    */
        input_v24(buffer);
        printf("Measurement result: %s\n",buffer);
/*****************************************************************/
/* Measurement with use of Operation Complete                    */
        printf("\n********** Measurement 3 **************\n");
        print_v24("*cls; :stat:opr:enab 0; *sre 0;"); /* clear old */
        print_v24("*ese 1; *sre 32;");    /* Path for SRQ      */
        print_v24(":start; *opc;");       /* Measure and wait  */
        waitsrq_v24();
        print_v24("*esr?;");              /* Query for OPC     */
        input_v24(buffer);
        printf("Standard event register: %s\n",buffer);
        print_v24(":RSLT:END?;");         /* Query for result  */
        input_v24(buffer);
        printf("Measurement result: %s\n",buffer);
/*****************************************************************/
/* Measurement with fetch of all intermediate results            */
        printf("\n********** Measurement 3 **************\n");
        print_v24("rslt:mask status,bec; ");
        print_v24(":start; ");          /* Measure             */
        while (1)
        {
            print_v24(":rslt:act?");    /* Query current value */
            input_v24(buffer);
            if(strncmp(buffer,"0",1))
               break;                   /* End of interval    */
            printf("Intermediate result: %s\n",buffer);
        }
        printf("Measurement result: %s\n",buffer);
/*****************************************************************/
/* End program                                                   */
        end_v24();
}
```

4.5.5 Controlling the SF-60 via a modem

```
/*****************************************************************/
/*     Wandel & Goltermann                                       */
/*     SF-60 controlled via PC                                   */
/*****************************************************************/
/*                                                               */
/*     File:                       modem.c                       */
/*                                                               */
/*                                                               */
/*     Matching to Turbo C 2.0                                   */
/*     The following modules are required:                       */
/*             modem.c                                           */
/*             module.c             Sub-functions                */
/*             module.h             Sub-function includes        */
/*             protos.h             Sub-function prototypes      */
/*                                                               */
/*     Application:                                              */
/*     Illustrates the use of the SF-60 with a modem type        */
/*     Microlink 2400. The device driver SERIAL.SYS              */
/*     must be loaded.                                           */
/*                                                               */
/*     copyright     W&G                                         */
/*****************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include <time.h>
#include "protos.h"
/*****************************************************************/
/* Initial settings of device driver and SF-60                   */

char          devicename[9] = "SF60";  /* Driver name           */
char          devicetyp[2] = "M";      /* P == PC, M == Modem   */
char          baudrate[5] = "2400";    /* 300,600,1200,2400,9600*/
char          databits[2] = "8";       /* 7 or 8                */
char          stopbits[2] = "1";       /* 1 or 2                */
char          parity[2] = "N";         /* NO, EVEN, ODD         */
char          handshake[2] = "S";      /* Software, Hardware    */
char          passwd[7] = "SF60";      /* Software, Hardware    */

int          exit_timeout = 1;         /* Abort program when
                                          timeout occurs.
                                          When setting to FALSE,
                                          the retcode of the
                                          driver functions must
                                          always be evaluated
                                        */
/*****************************************************************/
/* Record control commands of SF-60                              */

char  cmd0[] = "*CLS;:STAT:OPR:ENAB 0; DEV:ENAB 0; *SRE 0; *ESE 0;";
char  cmd1[] = "*SRE 0;";

char  buffer[1000];
```

```
/*****************************************************************/
/* Hang up       Clear down connection                           */
/*****************************************************************/
int     hangup(void)
{
char    tmp[40];
   clr_input();               /* Clear input buffer             */
   mod_cmdmod();              /* Switch to command mode         */
   modem_cmd("ATH0");         /* Clear down connection          */
   mod_reply(tmp);            /* Read reply                     */
   fprintf(stdout,"Clear down connection: %s \n",tmp);
return(0);
}
/*****************************************************************/
/* Dial          Dial up device                                  */
/*****************************************************************/
int     dial(void)
{
char    tmp[30];
int     retc;
   mo_send("AT");             /* Test if modem ready            */
   retc=mo_read(tmp);         /* Read echo                      */
   if ( retc)
   {
      mod_cmdmod();           /* Switch to command mode         */
      modem_cmd("ATH0");      /* Clear down connection          */
      fprintf(stdout,"Modem not in command mode \n");
      fprintf(stdout,"Start program again \n");
      exit(1);
   }
   else
   {
      mod_reply(tmp);                 /* Erase reply          */
   }
/*     modem_cmd("ATXDT 2111");       /* Call PABX using      */
                                      /* multifrequency dialling*/
       modem_cmd("AT DP >: 862111");  /* Call PABX using      */
                                      /* ground key and       */
                                      /* impulse dialling     */

      mod_reply(tmp);                 /* Evaluate reply       */
      if( (strncmp("CONNECT",tmp,7)) != 0)
      {.

         fprintf(stdout,"No connection available: %s\n",tmp);
         fprintf(stdout,"Program aborted\n");
         exit(1);
      }
      else
      {
         fprintf(stdout,"Connection: %s\n",tmp);
      }
return(0);
}
```

```
/*****************************************************************/
/* Main program                                                  */
/*****************************************************************/
void     main(void)
{
long     sta,sto;
char     pword[30];
int      i,retc;
         pword[0] = 0;
         strcat(pword,":PASSWD \"");       /* Form password     */
         strcat(pword,passwd);
         strcat(pword,"\";");
         clrscr();
/*****************************************************************/
/* Display transmission parameters                               */
     fprintf(stdout,"Driver name<%s> \n",devicename);
     fprintf(stdout,"Type: <%s> ",devicetyp);
     fprintf(stdout,"Baud: <%s> ",baudrate);
     fprintf(stdout,"Data: <%s> ",databits);
     fprintf(stdout,"Stop: <%s> ",stopbits);
     fprintf(stdout,"Pary: <%s> ",parity);
     fprintf(stdout,"Handsh: <%s>\n",handshake);
     fprintf(stdout,"Password: <%s>\n\n",passwd);

/*****************************************************************/
/* Explain application                                           */
     fprintf(stdout,"Controlling the SF-60 via modem \n");
     fprintf(stdout,"============================== \n");
     fprintf(stdout,"Application");
     fprintf(stdout," - Dial up device:\n");
     fprintf(stdout," - Query error status\n");
     fprintf(stdout," - Check if measurement ended\n");
     fprintf(stdout," - Check if a.c. line failure occurred\n");
     fprintf(stdout,"\n\n");
/*****************************************************************/
/* Set interface                                                 */
     initialize();

/*****************************************************************/
     set_timov24(40);              /* Set timeout of 40 sec     */
/*****************************************************************/
     fprintf(stdout,"Dial up SF-60\n");
     sta=clock();
     dial();                     /* Dial up device              */
     sto=clock();
     fprintf(stdout,"Dial duration: %0.2f sec\n",(sto-sta)/CLK_TCK);
```

```
/*****************************************************************/
     clr_input();
     fprintf(stdout,"Transmit password\n");
     print_v24(pword);
     fprintf(stdout,"Check error status.\n");
     print_v24(":err:cme?;");      /* Query error status          */
     input_v24(buffer);

     if ( strncmp(buffer,"0,",2))
     {
         fprintf( stdout,"\aError message CMD Error: \n");
         fprintf( stdout,"%s",buffer);
         fprintf( stdout,"\a\n");
     }

     print_v24(":err:exe?;");      /* Query error status          */
     input_v24(buffer);

     if ( strncmp(buffer,"0,",2))
     {
         fprintf( stdout,"\aError message EXE Error: \n");
         fprintf( stdout,"%s",buffer);
         fprintf( stdout,"\a\n");
     }
/*****************************************************************/
     print_v24("*esr?;");           /* Test for a.c. line fail  */
     input_v24(buffer);
     i=atoi(buffer);
     i &=0x80;                      /* Mask power on            */
     if(i)
     {
         fprintf( stdout,"AC line failure detected \n");
     }
/*****************************************************************/
     print_v24(":stat:oper:cond?;"); /* Test for measurement end*/
     input_v24(buffer);
     i=atoi(buffer);
     i &=0x1;                        /* Mask Busy               */
     if(i)
     {
         fprintf( stdout,"Measurement not yet ended.\n");
     }
     else
     {
         fprintf( stdout,"Measurement ended.\n");
     }
```

4.5.6 Functions of the file “shell.c”

```
/*********************************************************************/
/*     Wandel & Goltermann                                           */
/*     SF-60 controlled via RS 232 / IEEE bus                        */
/*********************************************************************/
/*                                                                   */
/*     File:                       shell.c                           */
/*                                                                   */
/*     Application:                                                  */
/*                                                                   */
/*     File includes all functions required to run an                */
/*     application independent of the interface type                 */
/*                                                                   */
/*     Requirements:                                                 */
/*     RS232          Driver serial.sys                              */
/*     IECBUS         National Instruments board                     */
/*                    Driver gpib.com                                */
/*********************************************************************/
/*     copyright          W&G                                        */
/*********************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include "protos.h"
/*********************************************************************/
/* Global variables used  ************************************/

extern     char     interface[];

/*********************************************************************/
/* Output to device                                                  */

int     print(char st[])
{
int     i;
    if ( interface[0] == 'I' || interface[0] == 'i')
        i=print_iec(st);
    else
        i=print_v24(st);
return(i);
}

/*********************************************************************/
/* Read from device                                                  */

int     input(char st[])
{
int     i;
    if ( interface[0] == 'I' || interface[0] == 'i')
        i=input_iec(st);
    else
       i=input_v24(st);
return(i);
}
```

```
/*****************************************************************/
/* Wait for SRQ                                                  */

int     waitsrq(void )
{
int     i;
    if ( interface[0] == 'I' || interface[0] == 'i')
        i=waitsrq_iec();
    else
       i=waitsrq_v24();
return(i);
}

/*****************************************************************/
/* Set timeout                                                   */

void     set_timo(unsigned int x)
{

    if ( interface[0] == 'I' || interface[0] == 'i')
       set_timoiec(x);
    else
       set_timov24(x);
}
```

4.5.7 Functions for controlling the SF-60 via the IEEE bus interface

```
/*****************************************************************/
/*     Wandel & Goltermann                                       */
/*     SF-60 controlled via RS 232 / IEEE bus                    */
/*****************************************************************/
/*                                                               */
/*       Example program for remote-controlling the SF-60        */
/*       modu_iec.c                                              */
/*                                                               */
/*       Application:                                            */
/*       This file contains all functions required for           */
/*       Controlling the SF-60 via the IEEE interface            */
/*                                                               */
/*     Requirements:                                             */
/*     IECBUS          National Instruments board                */
/*                     DEVICE=gpib.com                           */
/*****************************************************************/
/*     copyright       W&G                                       */
/*****************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <conio.h>
#include <dos.h>
#include "decl.h"
#include "protos.h"
#include "iecprot.h"

/*****************************************************************/
/* Internal function prototypes                                  */

int     error_iec(char *p);
```

```
/*****************************************************************/
/* Global variables                                              */

int             iec_dev_adr;
int             iec_contr_adr;
extern char     iecdevice[];
extern int      iecbusadr;

/*****************************************************************/
/* Set timeout                                                   */
void      set_timoiec(unsigned int s)
{

    if (s >= 1000)
        ibtmo(iec_dev_adr,17);              /* to 1000 seconds */
    else if (s >= 300)
        ibtmo(iec_dev_adr,16);              /* to  300 seconds */
    else if (s >= 100)
        ibtmo(iec_dev_adr,15);              /* to  100 seconds */
    else if (s >= 30)
        ibtmo(iec_dev_adr,14);              /* to   30 seconds */
    else if (s >= 10)
        ibtmo(iec_dev_adr,13);              /* to   10 seconds */
    else if (s >= 3)
        ibtmo(iec_dev_adr,12);              /* to    3 seconds */
    else if (s >= 1)
        ibtmo(iec_dev_adr,11);              /* to    1 second  */
    else
        ibtmo(iec_dev_adr,0);               /* to infinity     */

}
/*****************************************************************/
/* Open device if retcode negative error                         */
int       init_iec(void)
{
if ((iec_dev_adr = ibfind (iecdevice)) < 0)
{
      printf("\nError opening device %s\n",iecdevice);
      printf("Ibfind error; \n");
      printf("Start Ibconf or change device name!\n\n");
      exit (1);
}
/*****************************************************************/
/* Open board if retcode negative error                          */
if ((iec_contr_adr = ibfind ("GPIB0")) < 0)
{
      printf("\nError opening board GPIB0\n");
      printf("Ibfind error; \n");
      printf("Start Ibconf or change device name\n\n");
      exit (1);
}
/*****************************************************************/
ibeos(iec_dev_adr,0x1c);          /* Enable END and lf           */
      error_iec("Set driver");
ibeot(iec_dev_adr,1);             /* Send last byte with END     */
      error_iec("Set driver");
ibpad(iec_dev_adr,iecbusadr);     /* Set device address          */
      error_iec("Set driver");
ibtmo(iec_dev_adr,13);            /* Set timeout to 10 seconds   */
      error_iec("Set driver");
/* Clear the device                                             */
if (ibclr (iec_dev_adr) & ERR)
      error_iec("Set driver");
return(0);
}
```

```
/*****************************************************************/
/* Wait for SRQ                                                  */

int      waitsrq_iec(void)
{
int   sp;
      ibwait(iec_contr_adr,0x5000);  /* Wait for SRQ or timeout */
      ibrsp(iec_dev_adr,&sp);
      if (ibsta & 0x4000)
      {
          /* Timeout with srq */
          fprintf(stderr,"Timeout waiting for SRQ %xH\n",ibsta);
          error_iec("Waiting for SRQ\n");      /* Exit on error */
          return(-1);
      }
return(sp & 0x0ff);
}
/*****************************************************************/
/* Output to the device                                          */

int  print_iec( char *p)
{
int  i;
     /* Output to the device; number of bytes must be specified */
     ibwrt (iec_dev_adr,p,strlen(p));
     i=error_iec(p);            /* Exit on error and timeout    */
return(i);
}
/*****************************************************************/
/* Input from device                                             */
/* Retcode number of characters                                  */
int   input_iec(char *p)
{
    /* The number of characters must be specified                */
    /* If END is located earlier, the read operation             */
    /* will be aborted                                           */
    ibrd (iec_dev_adr,p,1000);
    error_iec(p);               /* Exit on error and timeout    */
    if(p[ibcnt-1] == '\n')
    {
          p[ibcnt-1] = '\0';
          return(ibcnt-1);
    }
    else
          return(ibcnt);
}
```

```
/*****************************************************************/
 /* Check error status and abort program                         */
 int   error_iec(char *p)
 {
     if ( ibsta & 0x8000)
     {
           /* Error detected */
           fprintf(stderr,"Program aborted due to\n");
           if ( ibsta & 0x4000)
           {
              /* Timeout */
              fprintf(stderr,"timeout and error.\n");
           }
           else
           {
              fprintf(stderr,"timeout.\n");
           }
           fprintf(stderr,"GPIB status:    0x%x\n",ibsta);
           fprintf(stderr,"Error status:  0x%x\n",iberr);
           fprintf(stderr,"Last action:  %s\n",p);

           exit(3);
     }
 return(0);
 }
```

4.5.8 Functions for controlling the device driver "serial.sys"

```
/*****************************************************************/
/*     Wandel & Goltermann                                       */
/*     SF-60 controlled via RS 232 interface                     */
/*****************************************************************/
/*                                                               */
/*     File:                      module.c                       */
/*                                                               */
/*     Application:                                              */
/*     Functions for controlling the device driver               */
/*     serial.sys.                                               */
/*                                                               */
/*     Requirements:                                             */
/*           module.h      Sub-function includes                 */
/*           protos.h      Sub-function prototypes               */
/*                                                               */
/*                                                               */
/*****************************************************************/
/*     copyright          W&G                                    */
/*****************************************************************/
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
#include <string.h>
#include <io.h>
#include <dos.h>
#include "protos.h"
#include "module.h"

/*****************************************************************/
/* Internal function prototypes                                  */

int ioctl_rd( RD_IOCTL_UNION      *arg);
int ioctl_wr( WR_IOCTL_UNION      *arg);
```

```
/*****************************************************************/
/* Global variables                                              */

int                 fh_device_out;
int                 fh_device_inp;
int                 actual_eos;
WR_IOCTL_UNION      wr_ioctl_union;
RD_IOCTL_UNION      rd_ioctl_union;

unsigned int            timeout = 10;      /* in seconds        */

/*****************************************************************/
/* mod_reply           Read in string                            */
/*****************************************************************/
/* Retcode = 0 if at least one character is read                 */
int      mod_reply(char *buf)
{
unsigned long      to = timeout*1000;      /* Convert to ms     */
int      always;
char     ch;
int      count = 0;
int      retc;

     if ( timeout == 0)
          always = TRUE;      /* No limiting                    */
     else
          always = FALSE;


     while (to > 0 ||  always)
     {
          retc = read(fh_device_inp, &ch, 1);
          if ( retc == 1)
          {
              if (ch != '\r')
              {
                 if (ch != '\n')
                 {
                      buf[count++] = ch;
                 }
                 else
                 {
                      buf[count++] = '\0';
                      always = TRUE;
                      break;
                 }
              }
          }
          else
          {
              /* No character received */
              delay(50);
              to -= 50;
              if (to <= 0 & !always)
                 break;
          }
      } /* End while */

      if (! always )
      {
          fprintf(stderr,"Timeout on input modem reply. \n");
          check_exit();
          return(1);      /* Abort due to timeout */
      }

return(0);
} /* mod_reply() */
```

```
/*****************************************************************/
/* mod_cmdmod            Switch modem to command mode            */
/*****************************************************************/
int      mod_cmdmod(void)
{
    delay(2000);      /* Wait one second */
    if (write(fh_device_out,"+++",3) != 3)
    {
          fprintf(stderr,"Error Output Escape \n");
          check_exit();
          return(2);
    }
    delay(2000);      /* Wait one second */
    clr_input();
return(0);
}

/*****************************************************************/
/* mo_send            Transmit modem command sequence            */
/*****************************************************************/
int      mo_send(char buf[])
{
int      lx;
         lx=strlen(buf);
         if (write(fh_device_out,buf,lx) != lx )
                return(1);

         if (write(fh_device_out,"\r",1) != 1)
                return(2);
return(0);
} /* mo_send */
/*****************************************************************/
/* mo_read            Read modem echo                            */
/*****************************************************************/
int      mo_read(char buf[])
{
int      count=0;
char     ch;

      if( (read(fh_device_inp, &ch, 1)) == 1)
      {
          if (ch != '\r')
               buf[count++] = ch;
      }
      else
      {
          return(1);            /* Abort if no character        */
      }

      /************ read in up to '\n' *************************/
      while(1)
      {
          if( (read(fh_device_inp, &ch, 1)) == 1)
          {
              if (ch != '\r')
              {
                  if (ch != '\n')
                      buf[count++] = ch;
                  else
                  {
                      buf[count++] = '\0';
                      break;
                  }
              }
          }
      }
return(0);
} /* mo_read */
```

```
/*****************************************************************/
/* modem_cmd            Address modem                            */
/*****************************************************************/
/* Transmit command and read echo                                */
int      modem_cmd(char *buf)
{
int      retc,i,count;
char     ch,tmp[40];
      if ( mo_send(buf) )
      {
          fprintf(stderr,"Error bei Modemoutput:  %s\n",buf);
          check_exit();
          return(1);
      }
      delay(100);
      /*******************************/
      /* Read modem echo             */
      /*******************************/
      if ( mo_read(tmp) )
      {
          fprintf(stderr,"Error: no modem echo:  %s\n",buf);
          check_exit();
          return(1);
      }
      else
      {
          fprintf(stdout,"Echo modem: %s\n",tmp);
      }

return(0); /* modem_cmd */
}
```

```
/*****************************************************************/
/* print_v24            Output string                            */
/*****************************************************************/
/* 0 is supplied as retcode if transfer okay                     */
int      print_v24(char *buf)
{
int      x;
char     tmpbuf[2];
   if (actual_eos == LF)
   {
      /* PC configuration set */

      if (write(fh_device_out,buf,strlen(buf)) != strlen(buf))
      {
          fprintf(stderr,"Error Output %s\n",buf);
          check_exit();
          return(2);
      }
      tmpbuf[0] = LF;
      if (write(fh_device_out,tmpbuf,1) != 1)
      {
          fprintf(stderr,"Error Output LF\n");
          check_exit();
          return(3);
      }
   }
   else
   {
      /* Modem configuration set */

      tmpbuf[0] = STX;
      if (write(fh_device_out,tmpbuf,1) != 1)
      {
          fprintf(stderr,"Error Output STX\n");
          check_exit();
          return(1);
      }

      if (write(fh_device_out,buf,strlen(buf)) != strlen(buf))
      {
          fprintf(stderr,"Error Output %s\n",buf);
          check_exit();
          return(2);
      }
      tmpbuf[0] = ETB;
      if ((x=write(fh_device_out,tmpbuf,1)) != 1)
      {
          fprintf(stderr,"Error Output ETB\n");
          fprintf(stderr,"Retcode %d \n",x);
          check_exit();
          return(3);
      }
   }

return (0);
}
```

```
/*****************************************************************/
/* input_v24            Read in string                           */
/*****************************************************************/
/* Retcode = 0 if at least 1 character is read                   */
int      input_v24(char *buf)
{
unsigned long      to = timeout*1000;      /* Convert to ms      */
int      always;
int      stopflag = FALSE;
char     ch;
int      count = 0;
int      retc;

      if ( timeout == 0)
          always = TRUE;      /* No limiting                     */
      else
          always = FALSE;


      while (to > 0 ||  always)
      {
          delay(50);
          to -= 50;
          wr_ioctl_union.fn3_wr.cmd_nr = 3;
          wr_ioctl_union.fn3_wr.error_mask = 0;
          wr_ioctl_union.fn3_wr.line_mask = 0;
          wr_ioctl_union.fn3_wr.event_mask = V24_EVENT_DATA;

          ioctl_wr(&wr_ioctl_union);
          ioctl_rd(&rd_ioctl_union);

          if (rd_ioctl_union.fn3_rd.event != 0)
          {
                always = TRUE;
                break;
          }
      }

      if (! always )
      {
          fprintf(stderr,"Timeout for input data \n");
          check_exit();
          return(1);      /* Abort due to timeout */
      }


      /* Read in string */
      while (! stopflag) {
          retc = read(fh_device_inp, &ch, 1);
          buf[count++] = ch;
          if (ch == actual_eos )
               stopflag = TRUE;
          if ( !retc )
          {
               stopflag = TRUE;
               fprintf(stderr,"EOS not found with input data\n");
          }
      }

      buf[count-1] = '\0';

      return(0);
} /* input_v24() */
```

```
/*****************************************************************/
/* waitsrq_v24            Wait for RQS from SF-60                */
/*****************************************************************/
/* Return: 0            if srq received                          */
int      waitsrq_v24(void)
{
int      always;
unsigned long      to = timeout*1000;      /* Convert to ms     */

      if ( timeout == 0)
          always = TRUE;      /* No limiting                     */
      else
          always = FALSE;

      while (to > 0 ||  always)
      {
          delay(50);
          to -= 50;

          wr_ioctl_union.fn3_wr.cmd_nr = 3;
          wr_ioctl_union.fn3_wr.error_mask = 0;
          wr_ioctl_union.fn3_wr.line_mask = 0;
          wr_ioctl_union.fn3_wr.event_mask = V24_EVENT_SRQ;

          ioctl_wr(&wr_ioctl_union);
          ioctl_rd(&rd_ioctl_union);
          if (rd_ioctl_union.fn3_rd.event != 0)
          {
               always = TRUE;
               break;
          }
      }

      if (! always )
      {
          printf("Timeout waiting for SRQ\n");
          check_exit();
          return(1);      /* Abort due to timeout */
      }

return(0);
} /* wait_srq() */

init_v24()
{

      _fmode = O_BINARY;            /* Default output is binary */

return (0);
}
```

```
/*****************************************************************/
/* check_exit            Abort program on timeout                */
/*****************************************************************/
void      check_exit(void)
{
      if ( exit_timeout)
      {
          show_status();                  /* Show driver status */
          fprintf(stderr,"Program aborted\n");
          exit(1);
      }
}
/*****************************************************************/
/* set_timov24            Set timeout for driver calls           */
/*****************************************************************/

void      set_timov24(unsigned int w)
{
                      /* Wait time in seconds            */
      if (w > 65)
      {
          timeout = 0xffff;
      }
      else
      {
          timeout = w * 1000;
      }
          wr_ioctl_union.fn12_wr.cmd_nr = 12;
          wr_ioctl_union.fn12_wr.timeout = timeout;
          ioctl_wr(&wr_ioctl_union);
      timeout = w;
}

/*****************************************************************/
/* ioctl...            DOS function shell                        */
/*****************************************************************/
int ioctl_rd(arg)
RD_IOCTL_UNION   *arg;
{
      ioctl(fh_device_inp, 2, arg, 100);
} /* ioctl_rd() */

int ioctl_wr(arg)
WR_IOCTL_UNION   *arg;
{
      ioctl(fh_device_out, 3, arg, 100);
} /* ioctl_wr() */

/*****************************************************************/
/* end_v24            End of application                         */
/*****************************************************************/
void      end_v24()
{
      close(fh_device_out );
      close(fh_device_inp );
}
```

```
/*****************************************************************/
/* initialize            Set driver                              */
/*****************************************************************/
void      initialize(void)
{

      /*************************************************************/
      /* Open driver                                               */
      _fmode = O_BINARY;      /* Default output is binary          */

      /* Open input device */
      if ((fh_device_inp = open(devicename,O_RDONLY )) < 0)
      {
          fprintf(stderr,"Can't open device %s\n",devicename);
          exit(1);
      }

      /* Open output device */
      if ((fh_device_out = open(devicename,O_RDWR | O_BINARY)) < 0)
      {
          fprintf(stderr,"Can't open device %s\n",devicename);
          exit(1);
      }
      /*************************************************************/
      /* Set interface                                             */
      config_v24();

}
```

```
/*****************************************************************/
/* Set configuration of serial interface                         */
/* Convert the global setting data                               */
/*****************************************************************/

int      config_v24(void)
{
    switch (devicetyp[0])
    {
      case 'p':
      case 'P':
          /* Set configuration without protocol */
          wr_ioctl_union.fn10_wr.cmd_nr = 10;
          wr_ioctl_union.fn10_wr.crc = 0;
          ioctl_wr(&wr_ioctl_union);

          wr_ioctl_union.fn11_wr.cmd_nr = 11;
          wr_ioctl_union.fn11_wr.protocol = 0;
          ioctl_wr(&wr_ioctl_union);

          actual_eos = LF;
          break;
      case 'm':
      case 'M':
          /* Set configuration with protocol */
          wr_ioctl_union.fn10_wr.cmd_nr = 10;
          wr_ioctl_union.fn10_wr.crc = 1;
          ioctl_wr(&wr_ioctl_union);

          wr_ioctl_union.fn11_wr.cmd_nr = 11;
          wr_ioctl_union.fn11_wr.protocol = 1;
          ioctl_wr(&wr_ioctl_union);

          actual_eos = ETB;
          break;
      default:
          fprintf(stderr,"Illegal devicetype for device '%s'\n",devicename);
          fprintf(stderr,"Choose from [P,M]\n");
          exit(1);
    }

    wr_ioctl_union.fn1_wr.eos = actual_eos;
    wr_ioctl_union.fn1_wr.srq = 7;

    wr_ioctl_union.fn1_wr.baudrate = atoi(baudrate);
    switch(wr_ioctl_union.fn1_wr.baudrate )
    {
      case 300:
      case 600:
      case 1200:
      case 2400:
      case 4800:
      case 9600:
          break;
      default:
          fprintf(stderr,"Illegal baudrate for device %s\n",devicename);
          fprintf(stderr,"Choose from [300,600,1200,2400,4800,9600]\n");
      exit(1);
    }

    switch(parity[0])
    {
      case 'n':
      case 'N':
          wr_ioctl_union.fn1_wr.parity = VP_NONE;
          break;
      case 'o':
      case 'O':
```

```
            wr_ioctl_union.fn1_wr.parity = VP_ODD;
            break;
        case 'e':
        case 'E':
            wr_ioctl_union.fn1_wr.parity = VP_EVEN;
            break;
        default:
            fprintf(stderr,"Illegal Parity '%c' for device
                            '%s'\n",parity[0],devicename);
                fprintf(stderr,"Choose from [n,o,e]\n");
            exit(1);
    }
    wr_ioctl_union.fn1_wr.databits = atoi(databits);
    switch(wr_ioctl_union.fn1_wr.databits )
    {
        case 7:
        case 8:
            break;
        default:
            fprintf(stderr,"Illegal data bits '%d' for device
            '%s'\n",wr_ioctl_union.fn1_wr.databits,devicename);
            fprintf(stderr,"Choose from [7,8]\n");
            exit(1);
    }

    wr_ioctl_union.fn1_wr.stopbits = atoi(stopbits);
    switch (wr_ioctl_union.fn1_wr.stopbits)
    {
        case 1:
        case 2:
            break;
        default:
            fprintf(stderr,"Illegal stop bits '%d' for device
            '%s'\n",wr_ioctl_union.fn1_wr.stopbits,devicename);
            fprintf(stderr,"Choose from [1,2]\n");
            exit(1);
    }
    switch (handshake[0])
    {
        case 'h':
        case 'H':
            wr_ioctl_union.fn1_wr.handshake = VHS_HW;
            break;
        case 'S':
        case 's':
            wr_ioctl_union.fn1_wr.handshake = VHS_SW;
            break;
        default:
            fprintf(stderr,"Illegal handshake-flag '%c' for device
                                '%s'\n",handshake[0],devicename);
            fprintf(stderr,"Choose from [s,h]\n");
            exit(1);
    }

    /* Set device driver */
    wr_ioctl_union.fn1_wr.cmd_nr = 1;
    ioctl_wr(&wr_ioctl_union);

    /* Clear input buffer */
    clr_output();

    /* Clear output buffer */
    clr_input();
return(0);
}
```

```
/*****************************************************************/
/* show_status            Display status                         */
/*****************************************************************/

void show_status(void)
{

      wr_ioctl_union.fn3_wr.cmd_nr = 3;
      wr_ioctl_union.fn3_wr.error_mask = 0xffff;
      wr_ioctl_union.fn3_wr.line_mask = 0xffff;
      wr_ioctl_union.fn3_wr.event_mask = 0xffff;

      ioctl_wr( &wr_ioctl_union);
      ioctl_rd( &rd_ioctl_union);

      fprintf(stderr,"Circuits set: ");
      if (rd_ioctl_union.fn3_rd.line & V24_STAT_DTR)
          fprintf(stderr,"DTR ");
      if (rd_ioctl_union.fn3_rd.line & V24_STAT_DSR)
          fprintf(stderr,"DSR ");
      if (rd_ioctl_union.fn3_rd.line & V24_STAT_RTS)
          fprintf(stderr,"RTS ");
      if (rd_ioctl_union.fn3_rd.line & V24_STAT_CTS)
          fprintf(stderr,"CTS ");
      if (rd_ioctl_union.fn3_rd.line & V24_STAT_DCD)
          fprintf(stderr,"DCD ");
      if (rd_ioctl_union.fn3_rd.line & V24_STAT_RI)
          fprintf(stderr,"RI ");
      fprintf(stderr,"\n");

      fprintf(stderr,"Errors occurred: ");
      if (rd_ioctl_union.fn3_rd.error & V24_ERR_FRM)
          fprintf(stderr,"Frame ");
      if (rd_ioctl_union.fn3_rd.error & V24_ERR_PAR)
          fprintf(stderr,"Parity ");
      if (rd_ioctl_union.fn3_rd.error & V24_ERR_OVR)
          fprintf(stderr,"Overrun ");
      if (rd_ioctl_union.fn3_rd.error & V24_ERR_BFL)
          fprintf(stderr,"Buffer full ");
      fprintf(stderr,"\n");

      fprintf(stderr,"Events occurred: ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_BD)
          fprintf(stderr,"break ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_RI)
          fprintf(stderr,"ring ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_DCD)
          fprintf(stderr,"dcd ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_DATA)
          fprintf(stderr,"data ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_ACK)
          fprintf(stderr,"ack ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_NAK)
          fprintf(stderr,"nak ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_ENQ)
          fprintf(stderr,"enq ");
      if (rd_ioctl_union.fn3_rd.event & V24_EVENT_SRQ)
          fprintf(stderr,"srq ");
      fprintf(stderr,"\n\a");

      fprintf(stderr,"No. of characters in receive buffer:
                    %d\n",rd_ioctl_union.fn3_rd.n_bytes);

} /* show_conf() */
```

```
/*****************************************************************/
/* show_config            Display configuration                  */
/*****************************************************************/

void show_config(void)
{
   int      xxx;

   wr_ioctl_union.fn2_wr.cmd_nr = 2;
   ioctl_wr( &wr_ioctl_union);
   ioctl_rd( &rd_ioctl_union);

   fprintf(stdout,"Baudrate:\t\t%d\n",rd_ioctl_union.fn2_rd.baudrate);
   fprintf(stdout,"Databits:\t\t%d\n",rd_ioctl_union.fn2_rd.databits);
   fprintf(stdout,"Stopbits:\t\t%d\n",rd_ioctl_union.fn2_rd.stopbits);
   fprintf(stdout,"EOS:\t\t\t%d\n",rd_ioctl_union.fn2_rd.eos);
   fprintf(stdout,"SRQ:\t\t\t%d\n",rd_ioctl_union.fn2_rd.srq);
   fprintf(stdout,"Parity:\t\t\t%d\t(none,even,odd)\n",
                                    rd_ioctl_union.fn2_rd.parity);
   fprintf(stdout,"RX mode:\t\t%d\t(string,char)\n",
                                    rd_ioctl_union.fn2_rd.rx_mode);
   fprintf(stdout,"Handshake:\t\t%d\t(SW,HW)\n",
                                    rd_ioctl_union.fn2_rd.handshake);
   fprintf(stdout,"RX buffer length:\t%d\n",rd_ioctl_union.fn2_rd.rx_buf_len);
   fprintf(stdout,"TX buffer length:\t%d\n",rd_ioctl_union.fn2_rd.tx_buf_len);
   fprintf(stdout,"RX upper limit:\t\t%d\n",rd_ioctl_union.fn2_rd.rx_upplim);
   fprintf(stdout,"RX lower limit:\t\t%d\n",rd_ioctl_union.fn2_rd.rx_lowlim);
   fprintf(stdout,"CRC:\t\t\t%d\t(off,on)\n", rd_ioctl_union.fn2_rd.crc);
  fprintf(stdout,"Protocol:\t\t%d\t(off,on)\n",rd_ioctl_union.fn2_rd.protocol);

} /* show_config() */

/*****************************************************************/
/* clr_input            Clear input buffer                       */
/*****************************************************************/
void      clr_input(void)
{
    wr_ioctl_union.fn6_wr.cmd_nr = 6;
    ioctl_wr(&wr_ioctl_union);

}
/*****************************************************************/
/* clr_output           Clear output buffer                      */
/*****************************************************************/
void      clr_output(void)
{
    wr_ioctl_union.fn7_wr.cmd_nr = 7;
    ioctl_wr(&wr_ioctl_union);

}
```

6 Theory, standards and recommendations

This section provides experienced users with background information, e.g. on the subjects of

- algorithms
- measurement methods.

6.1 CRC sum calculation for modem operation

The CRC sum used is a 16-bit check-sum for bit-oriented procedures as specified by the ITU-T.
The polynomial used is: $x^{16} + x^{12} + x^5 + 1$

The CRC sum is calculated from the data bits only. It is converted to a hexadecimal number and transmitted as ASCII characters with the most significant byte first.

The following algorithm can be used for the calculation:

```
    crc  =      0
    len  =      <string length>
    i    =      <position of first character>

A:  c    =      <byte for position i>
    q    =      (crc XOR c) AND 15
    crc  =      (crc / 16) XOR (q * 4225)
    q    =      (crc XOR (c / 16)) AND 15
    crc  =      (crc / 16) XOR (q * 4225)
    i    =      i + 1
    len  =      len - 1
    if (len > 0) then goto A
```

6.2 Bit slip measurement

A bit slip occurs when the received pattern is offset in relation to the reference pattern, as shown in figure 6-1:

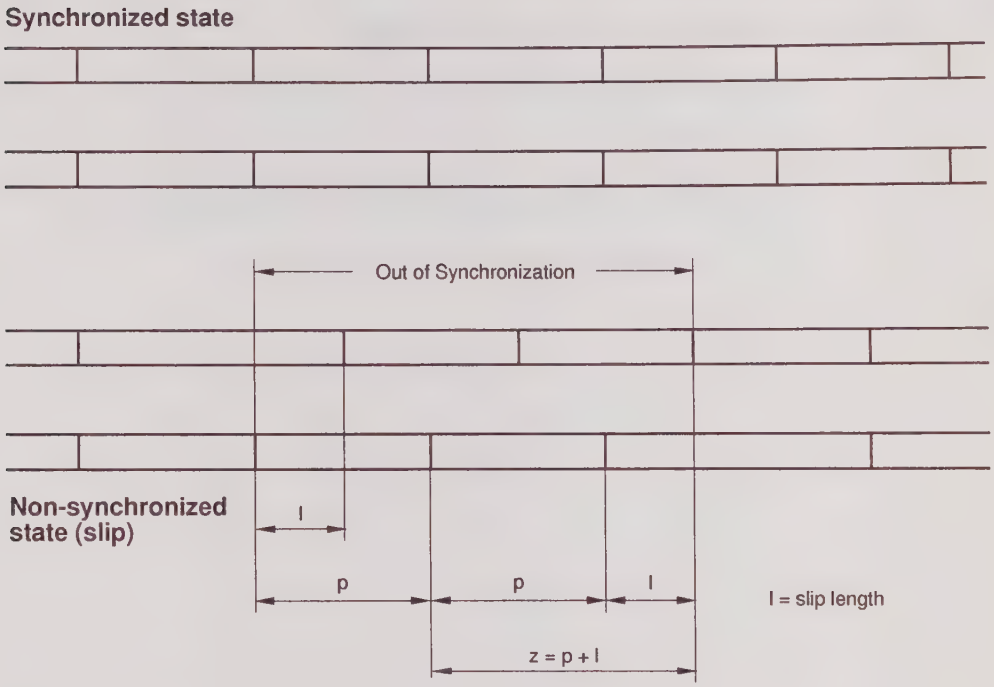


Fig. 6-1 Bit slip

The received pattern contains a pattern slip of length l (measured in bits or clock pulses).
The magnitude of the measured pattern slip, d, is given by:
$d = z - p \times integer\ (z / p)$

The SF-60 calculates the length of the slip, l, as follows:
For 0 d p/2: l = d
for p/2 < d < p: l = d - p

where:
d = magnitude of measured slip
l = length of measured slip
p = pattern period
z = slip counter value

Example

p = 32767 bits (PRBS 2^{15}-1)

z = 118731 bits

d = 118731 bits - 32767 bits x integer (118731 bits / 32767 bits)

d = 118731 bits - 32767 bits x 3 = 20430 bits

Since p/2 < d < p, **l = d - p**

The length of the bit slip, l, is therefore:

l = d - p = (20430 - 32767) bits = **12337 bits**

6.3 Basic principles of synchronous transmission

Refer to the pocket reference book "Measurement technology for synchronous transmission systems" located in the pouch inside the front cover of this manual.

The following subsections summarize the STM-1 frame structure, the functions of the SOH bytes and the SDH alarms.

6.3.1 STM-1 frame structure

A1, A2	Frame alignment	1*	All bits = "1"
B1	Parity word for error detection (BIP-8)	Y	1001 SS1 (S bits are undefined)
B2	Parity word for error detection (BIP-24)	J1	Path identifier
C1	STM-1 identifierin STM-N	B3	Parity word for error detection (BIP-8)
D1 to D12	Data channels for in-service monitoring	C2	VC payload identifier
E1, E2	Service channels for speech transmissions	G1	Path status
F1	User channel	F2	Path user channel
K1, K2	Back-up circuit control	H4	Multiframe identifier
Z1, Z2	Reserve channels	Z3 to Z5	Reserve channels

△ Dependent on transmission medium

╳ Reserved for national use

Fig. 6-2 STM-1 frame structure

6.3.2 AU pointer information

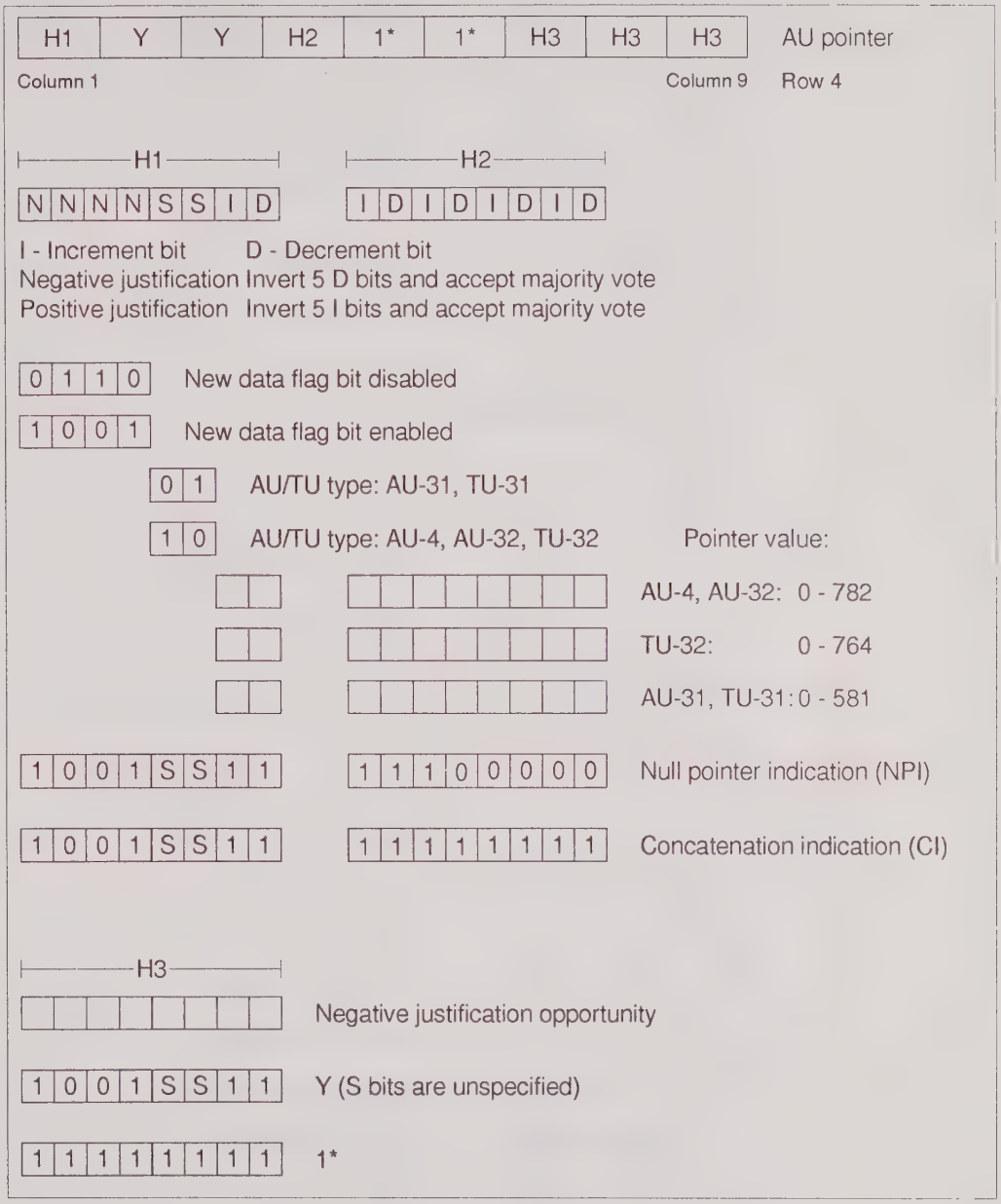

H1 Y Y H2 1* 1* H3 H3 H3
AU pointer
Column 1
Column 9
Row 4
H1
H2
N N N N S S I D
I D I D I D I D
I - Increment bit D - Decrement bit
Negative justification Invert 5 D bits and accept majority vote
Positive justification Invert 5 I bits and accept majority vote
0 1 1 0 New data flag bit disabled
1 0 0 1 New data flag bit enabled
0 1 AU/TU type: AU-31, TU-31
1 0 AU/TU type: AU-4, AU-32, TU-32
Pointer value:
AU-4, AU-32: 0 - 782
TU-32: 0 - 764
AU-31, TU-31: 0 - 581
1 0 0 1 S S 1 1
1 1 1 0 0 0 0 0 Null pointer indication (NPI)
1 0 0 1 S S 1 1
1 1 1 1 1 1 1 1 Concatenation indication (CI)
H3
Negative justification opportunity
1 0 0 1 S S 1 1 Y (S bits are unspecified)
1 1 1 1 1 1 1 1 1*

Fig. 6-3 AU pointer coding

6.3.3 RSOH information

A1, A2

1 1 1 1 0 1 1 0	A1	Framing byte 1
1 1 1 1 0 1 1 0	A1	Framing byte 2
1 1 1 1 0 1 1 0	A1	Framing byte 3
0 0 1 0 1 0 0 0	A2	Framing byte 1
0 0 1 0 1 0 0 0	A2	Framing byte 2
0 0 1 0 1 0 0 0	A2	Framing byte 3

Fig. 6-4 A1 and A2 byte coding

B1, C1, E1

	B1	Bit interleaved parity (BIP-8)
	C1	STM identifier
	E1	Order wire

Fig. 6-5 B1, C1 and E1 byte coding

F1

S S RI RI RI RI RI RI	F1 User channel
0 0	Normal
0 1	MAJ ERR B1 error rate exceeds threshold
1 0	REC Loss of frame alignment or loss signal
1 1	ERR MON B1 error rate goes below threshold
RI RI RI RI RI RI	Regenerator indentifier

Fig. 6-6 F1 byte coding

D1 to D3

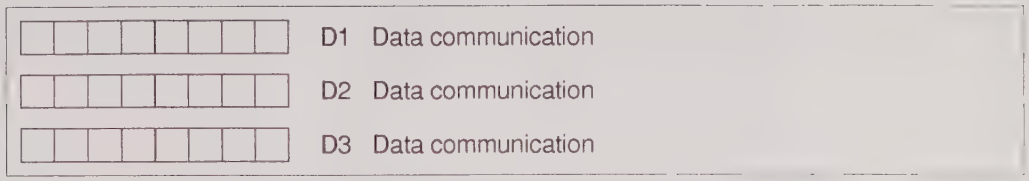


Fig. 6-7 D1, D2, D3 byte coding

6.3.4 MSOH information

B2, D4 to D12, E2

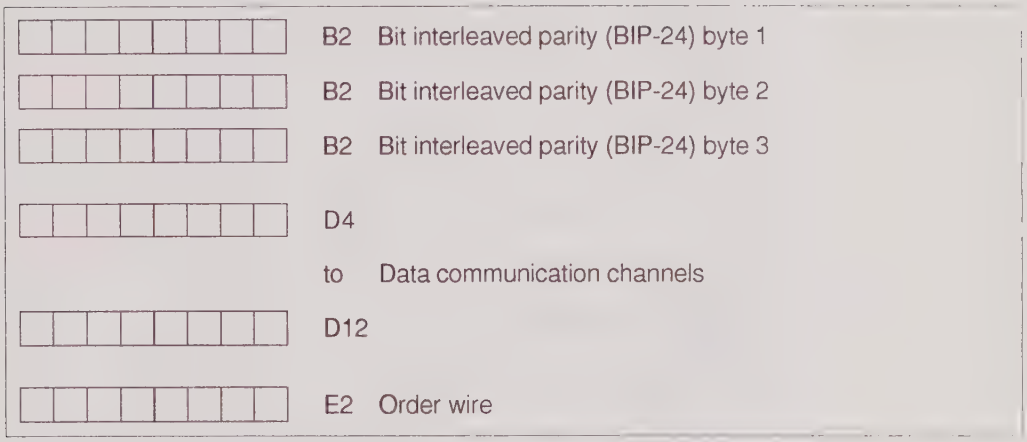

B2 Bit interleaved parity (BIP-24) byte 1
B2 Bit interleaved parity (BIP-24) byte 2
B2 Bit interleaved parity (BIP-24) byte 3
D4
to Data communication channels
D12
E2 Order wire

Fig. 6-8 B2, D4 to D12 and E2 byte coding

K1

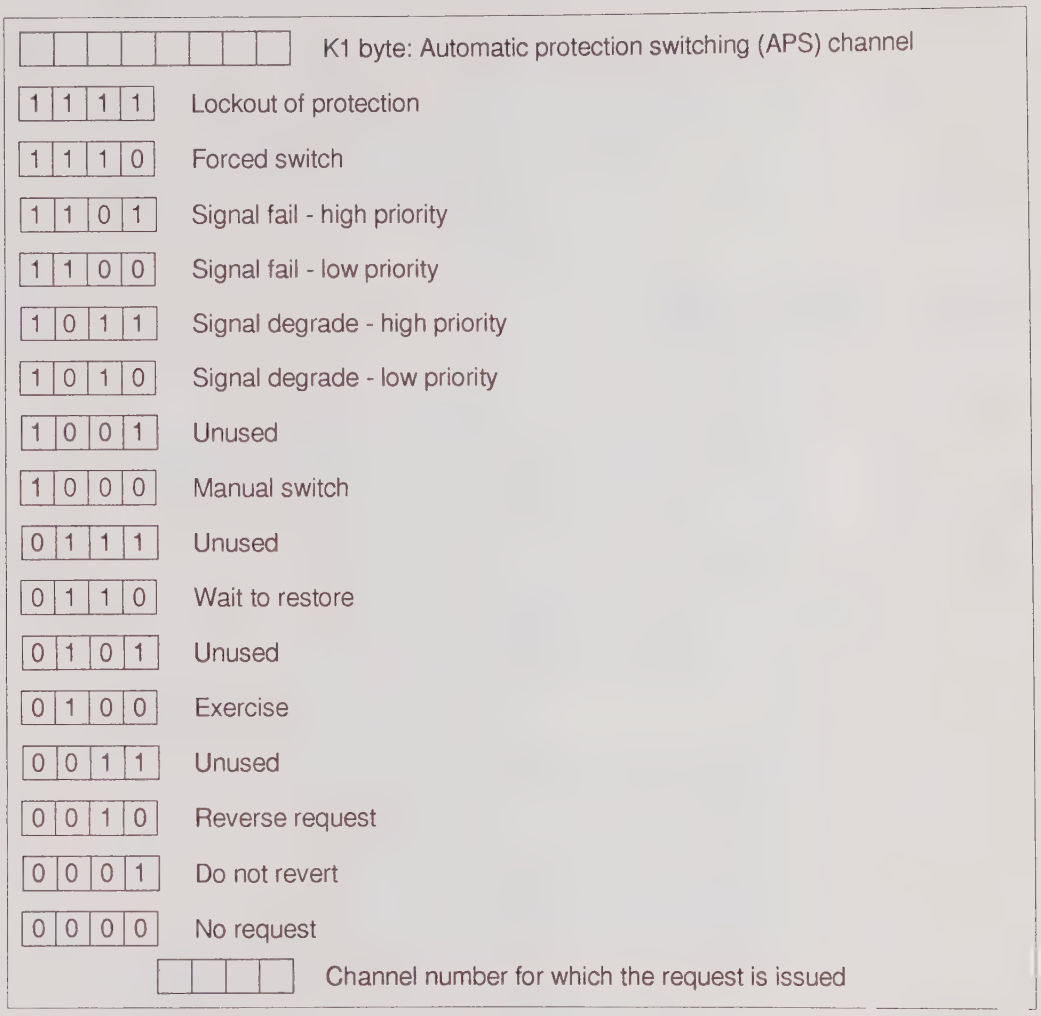

K1 byte: Automatic protection switching (APS) channel
1 1 1 1 Lockout of protection
1 1 1 0 Forced switch
1 1 0 1 Signal fail - high priority
1 1 0 0 Signal fail - low priority
1 0 1 1 Signal degrade - high priority
1 0 1 0 Signal degrade - low priority
1 0 0 1 Unused
1 0 0 0 Manual switch
0 1 1 1 Unused
0 1 1 0 Wait to restore
0 1 0 1 Unused
0 1 0 0 Exercise
0 0 1 1 Unused
0 0 1 0 Reverse request
0 0 0 1 Do not revert
0 0 0 0 No request
Channel number for which the request is issued

Fig. 6-9 K1 byte coding

K2

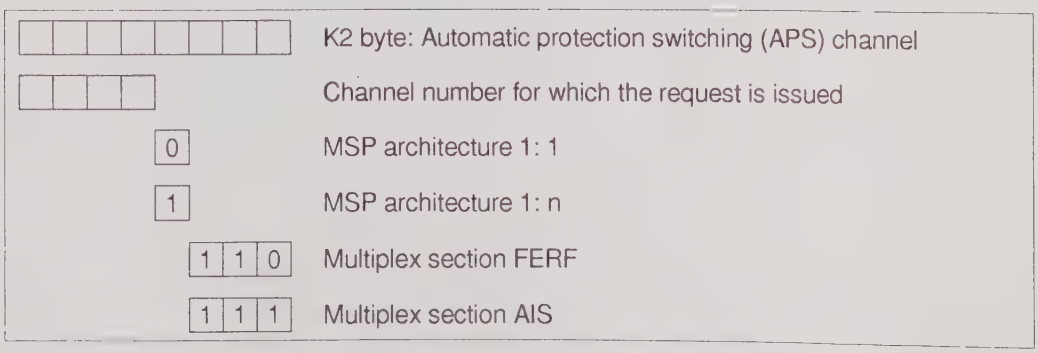

K2 byte: Automatic protection switching (APS) channel
Channel number for which the request is issued
0 MSP architecture 1: 1
1 MSP architecture 1: n
1 1 0 Multiplex section FERF
1 1 1 Multiplex section AIS

Fig. 6-10 K2 byte coding

Z1, Z2

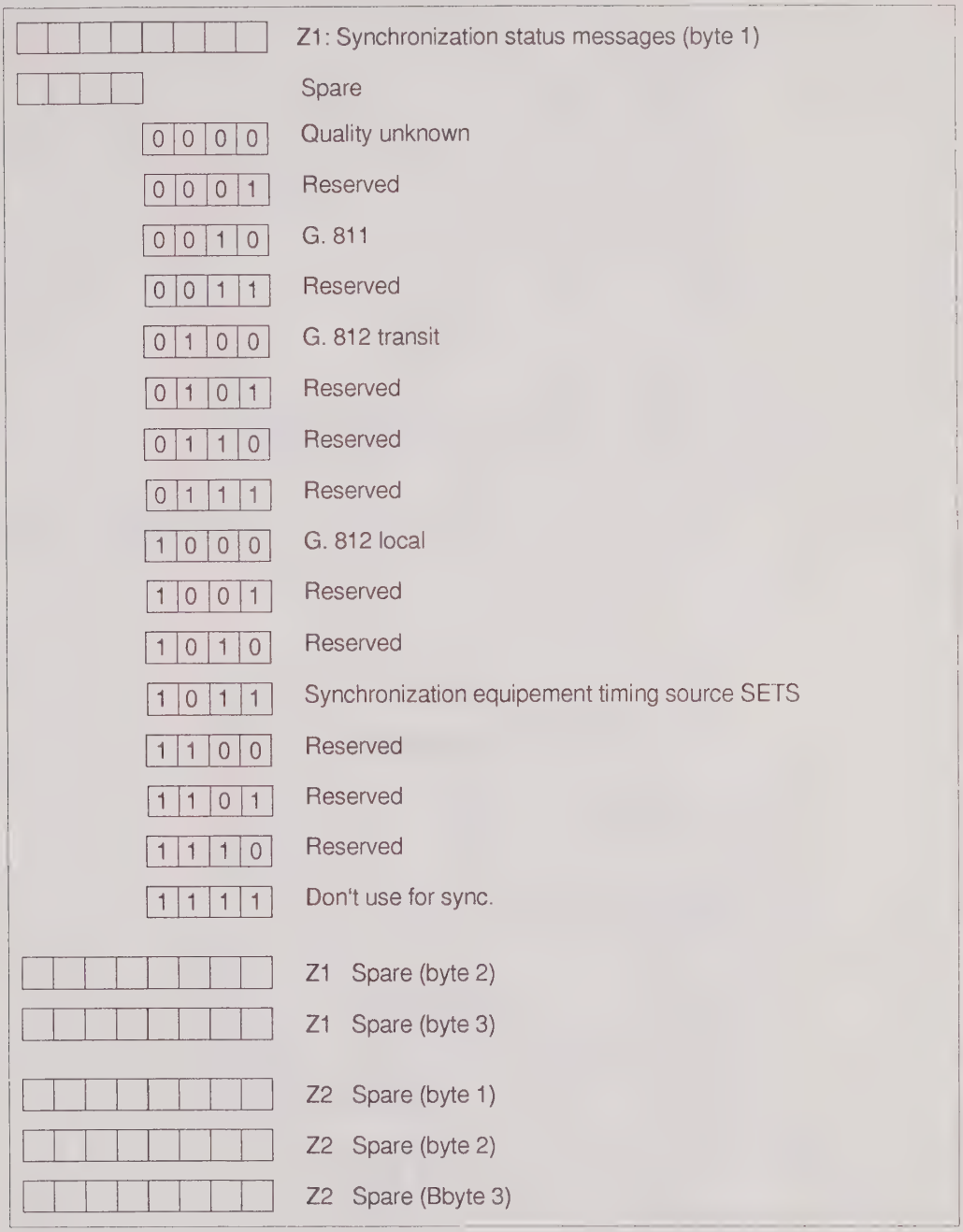

Z1: Synchronization status messages (byte 1)
Spare
0 0 0 0 Quality unknown
0 0 0 1 Reserved
0 0 1 0 G. 811
0 0 1 1 Reserved
0 1 0 0 G. 812 transit
0 1 0 1 Reserved
0 1 1 0 Reserved
0 1 1 1 Reserved
1 0 0 0 G. 812 local
1 0 0 1 Reserved
1 0 1 0 Reserved
1 0 1 1 Synchronization equipement timing source SETS
1 1 0 0 Reserved
1 1 0 1 Reserved
1 1 1 0 Reserved
1 1 1 1 Don't use for sync.
Z1 Spare (byte 2)
Z1 Spare (byte 3)
Z2 Spare (byte 1)
Z2 Spare (byte 2)
Z2 Spare (Bbyte 3)

Fig. 6-11 Z1 and Z2 byte coding

STM-1 In-service maintenance alarms

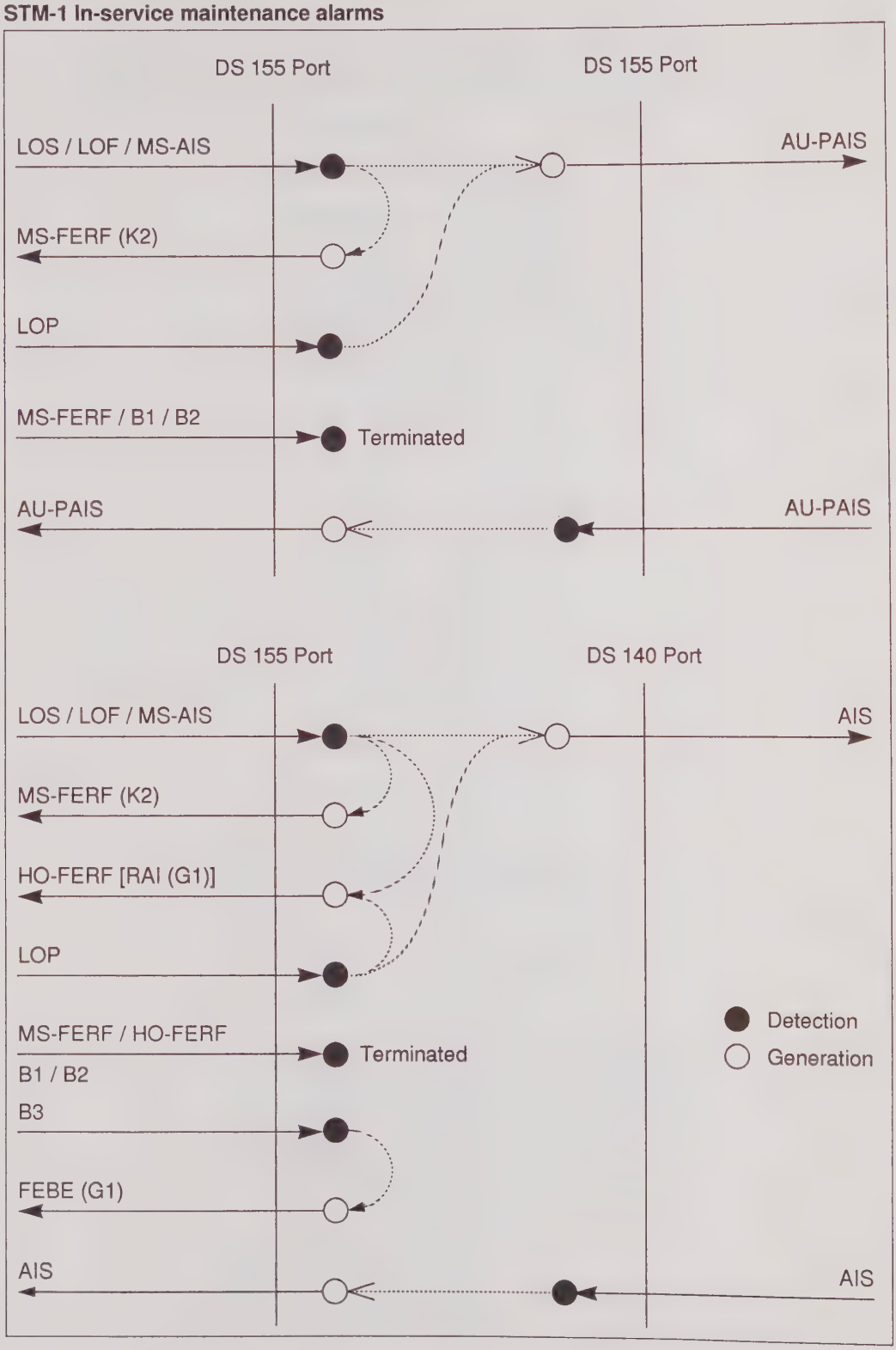


Fig. 6-12 STM-1 In-service maintenance alarms

STM-1 In-service maintenance alarms

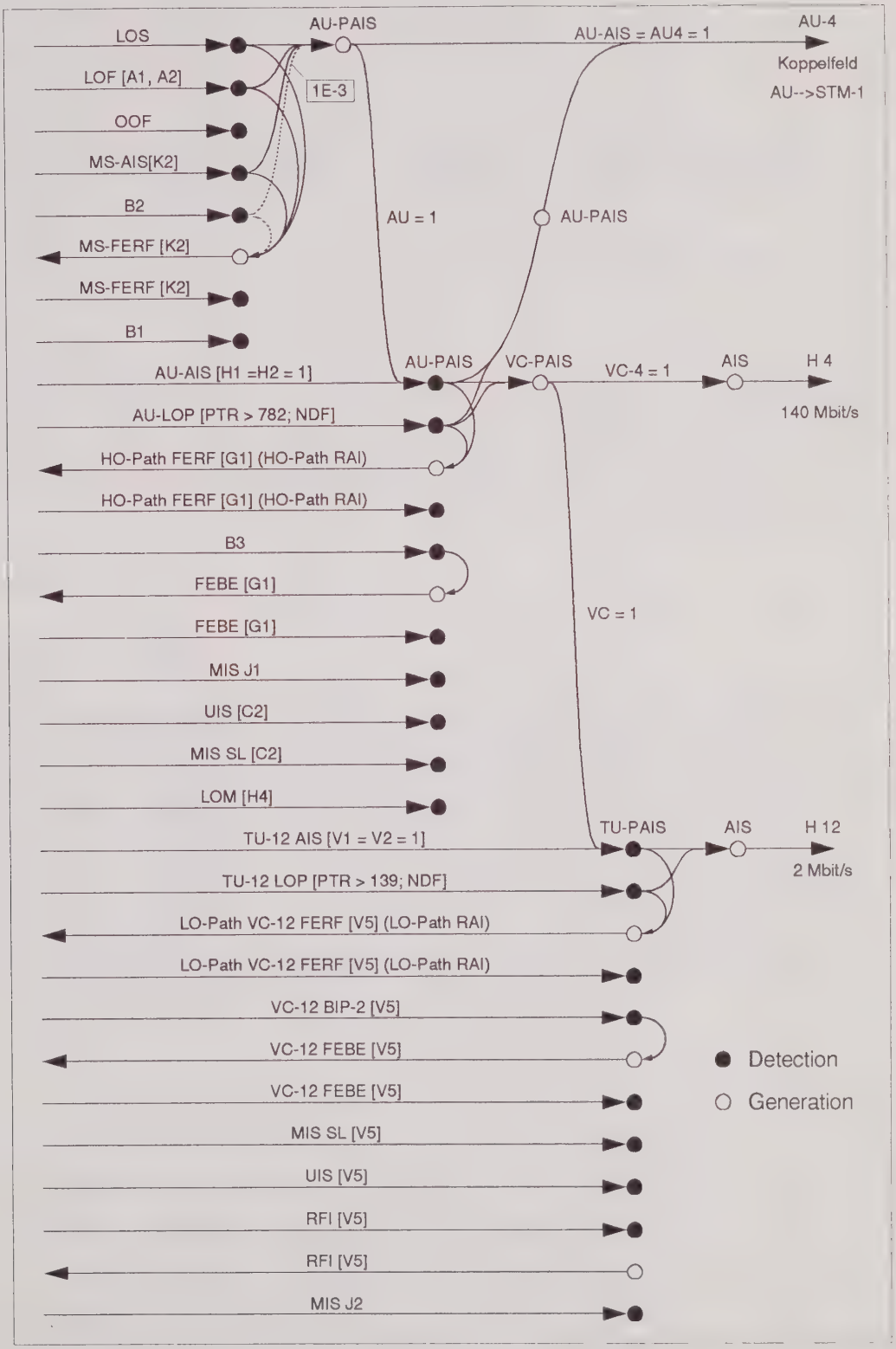


Fig. 6-13 STM-1 In-service maintenance alarms

7 Calibration, maintenance and disposal

7.1 Calibration

Traceability

Instruments manufactured by Wandel & Goltermann are tested and calibrated against standards which can be traced back to national standards such as those preserved by the Physikalischen Technischen Bundesanstalt (Federal German Bureau of Metrology) in Braunschweig, Germany.

Wandel & Goltermann's own calibration service is a member of the German Calibration Service with the number DKD 00501.

Calibration intervals

The calibration interval chosen depends on various conditions. If an instrument is used under extreme conditions or subjected to rough handling, the effects of aging will usually be more apparent than if the instrument is operated under constant and temperate ambient conditions.

We recommend that the instrument be calibrated initially at intervals of one year, assuming normal handling and average accuracy requirements.

For all queries involving calibration, contact your local Wandel & Goltermann service center.

7.2 Maintenance

7.2.1 Cleaning the instrument

Before cleaning the instrument, disconnect it from all power sources. Simply switching it off using the power switch is not sufficient protection against electrical accidents.

Never use solvents such as denatured alcohol or petroleum for cleaning, as these may attack the lettering and finish of the instrument. Cleansers for plastic surfaces or furniture should also be avoided, as these often contain polishing agents which may also damage the lettering and finish of the instrument.

To clean the instrument, moisten a cloth with warm water to which a little detergent has been added. Make sure that no water enters the instrument. Wipe off damp surfaces with a dry cloth to remove any marks.

The display panel should be wiped over with a damp cloth only, to avoid scratching it and building up static charges.

7.2.2 Cleaning the optical interfaces

To clean the optical interfaces [38] and [39], proceed as follows:

- Remove the adapters or protective covers. The internal plug pin is now easily accessible.
- If the pin is very dirty, lightly dab the end-face of the plug with a length of adhesive tape such as Scotch "Magic Tape" or similar.
- If the pin is only slightly dirty, moisten a lint-free paper wipe with isopropyl alcohol and wipe the end-face of the plug gently.
- Wipe off the end-face of the plug with a clean, dry lint-free paper wipe.
- Clean the removed adapter using clean compressed air.

Replace the adapters or protective covers.

A suitable microscope with a magnification of about 200 x should be used for inspecting the plug end-faces. For regular inspection in the laboratory or on-site, We recommend the use of the BUEHLER FIBRSKOPE 0801 - 9505, a hand-held microscope manufactured by Buehler Ltd., 41 Waugekan Road, Lake Bluff, Illinois 60044, USA.

7.2.3 Accessory box

The accessory box, located on the back panel of the instrument, contains the tools required for opening the instrument or for changing a fuse.

Contents:

- Card puller
  For removing the covers of screening cans and extracting the p.c. boards which the cans contain. Provided for the use of service personnel only.
- 2 hex (Allen) keys
  For the hex socket screws which fasten the instrument cover and the display frame.
- Special spanner
  For the inserts for the Versacon® 9 connector system
- Two 5 A quick-blow fuses.

7.2.4 Exchanging the Versacon inserts

Some of the instrument's inputs and outputs are fitted ex-works with BNC sockets. The BNC inserts can be replaced with other connectors in the Versacon® 9 range (figure 7-1). Use the special spanner provided.

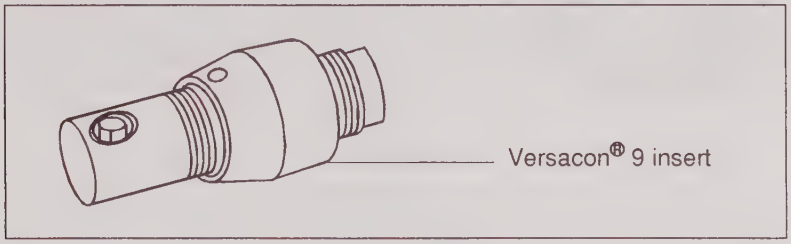


Fig. 7-1 Versacon® 9 BNC socket insert

Removing the socket

1 Loosen the locknut by turning it anti-clockwise using the special spanner
2 Unscrew the locknut by hand as far forward as it will go.
3 The insert can now be unscrewed. If necessary, use the special spanner.

Fitting the socket

1 Screw the locknut by hand onto the insert as far as it will go.
2 Screw the insert as far as it will go into the socket on the instrument.
3 Screw down the locknut by hand until it stops and then tighten it using the special spanner.

7.2.5 Changing the fuse

If the instrument does not work after being switched on and the a.c. line cord appears to be in order, it is possible that the fuse may have blown. To replace a blown fuse, proceed as follows:

1 **Disconnect the instrument from all power sources!**
2 Open the fuse holder (located on the back of the instrument to the left of the a.c. line connector) by turning it by about 45° to the left using a screwdriver. The fuse-holder will then pop out.
3 Remove the fuse and check it for continuity. If the fuse is defective, replace it with a new one; two spares are provided in the accessory box.
4 Replace the fuse-holder in the instrument. Press it down into the opening and turn it to the right using the screwdriver until it locks into position.
5 Reconnect the instrument to the a.c. power line and switch it on.

If the replaced fuse also fails, contact your local Wandel & Goltermann service representative for advice.

7.2.6 Changing the air filter

Cooling for the SF-60 is provided by sucking air through the left hand side of the casing. Two air filters placed side-by-side behind the left hand side panel remove dust and dirt particles from the airflow.

These air filters must be replaced at regular intervals, which will depend on the conditions under which the instrument is normally used. If this is not done, or if the instrument is operated with the air filters removed, damage to the instrument may occur due to the accumulation of dust and dirt.

The diagram on the next page (figure 7-2) and the following instructions show how the air filter is exchanged:

1 **Disconnect the instrument from all power sources.**
2 Place the SF-60 on its right side (as seen from the front)
3 Undo the three hex socket screws at the top of the top and bottom covers.
4 Remove the left-hand side cover of the instrument
5 Press the holding clips together and remove them
6 Remove the dirty filter pads and replace them with new ones
7 Replace the holding clips
8 Replace the left-hand side cover of the instrument and fasten it in position using the hex socket screws.

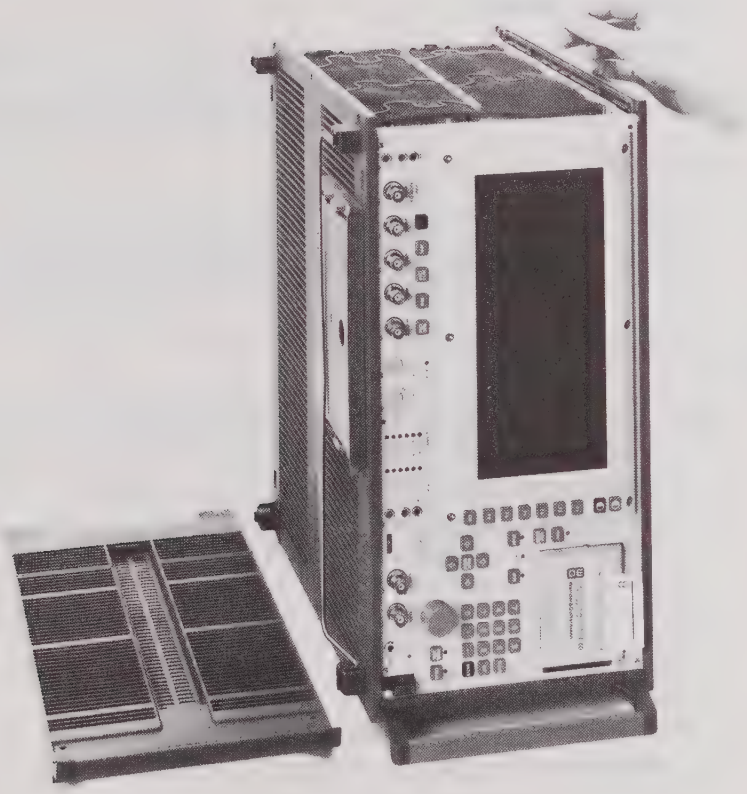


Fig. 7-2 Changing the air filter pads

7.3 Removing the Nickel-Cadmium batteries

Two NiCd rechargeable batteries are located on the CPU board of the SF-60. These are used to supply power for storing device setups and internal data when the SF-60 is disconnected from the a.c. line.

These batteries must be removed for correct disposal when the instrument is scrapped. The following instructions apply only when the SF-60 is scrapped. If the batteries need to be changed for any other reason, or if you do not wish to remove the batteries yourself, contact your local Wandel & Goltermann service center.

To remove the batteries, proceed as follows:

1 **Disconnect the SF-60 from all power sources.**
2 Remove the top cover, left-hand side panel and base panel of the instrument using the hex (Allen) key located in the accessory box.
3 Remove the grey back panel cover plate.
4 The CPU board (recognizable by the two remote-control sockets [44] and [45] and the address switch) is located behind the center one of the three aluminium covers placed one above the other. Remove the 24 fixing screws using a screwdriver and remove the cover plate.
5 Use the card puller (found in the accessory box) to pull out the CPU board towards the rear.
6 The batteries (front left) can now be removed and disposed of as prescribed by local regulations.

8 Specifications

Unless otherwise stated,

the specified values are only guaranteed values when the instrument is operated within the range limits specified in section 8.11.

ECL input signal levels are: HIGH -0.7 to -1.1 V
LOW -1.5 to -4.5 V

The numbers in square brackets [] correspond to the numbers of the connectors and control elements shown in figures 3-1 and 3-2 (front and back panel diagrams) located at the start of section 3.

This section also includes the specifications for the options which can be fitted to the SF-60 mainframe, such as the frame options (see under "Options", section 8.11.7.2).

8.1 Generator

8.1.1 Bit rates, clock sources

8.1.1.1 Internal clock generator

Frequency range (kHz)	Setting step width (kHz)
48.00 to 999.99	0.01
1000 to 175 000	1

Frequency deviation . . . . . ± 2 ppm
aging, additional . . . . . ± 1 ppm p.a.
Offset (switchable: ppm/ppb)
in the range . . . . . ± 999 ppm
Setting step width . . . . . 1 ppm
in the range . . . . . ± 999.999 ppb
Setting step width . . . . . 0.001 ppb
referred to a clock frequency of 155.520 MHz.

Note: 1 ppm = 10^{-6}
1 ppb = 10^{-9}

8.1.1.2 External clock input [41]

Input impedance . . . . . 75 Ω
Peak voltage requirements
(sine- or square-wave) . . . . . ± 1 to 3 V
Max. permitted peak input voltage level . . . . . ± 5.0 V

Transparent external clock

Note: The "clock divider" option (see section 8.11.7.2) is required
– for synchronizing the generator of the SF-60 to the clock of a received STM-1 signal or
– if no 2048 kHz system clock is available.
The clock divider must be connected between output [46] and input [41].

Clock frequency range . . . . . 1 to 175000 kHz

Duty cycle 0.5

(This signal determines the output pulse duration).

Internal clock generator synchronized

Synchronization to 2048 kHz

Clock frequency . . . . . 2048 kHz ± 20 ppm

Measurement of transparent external clock

Measurement range (kHz)			Resolution (kHz)
1.000	to	99.999	0.001
100.00	to	999.99	0.01
1 000.0	to	9 999.9	0.1
10 000	to	175 000	1

8.1.2 Outputs and line codes

8.1.2.1 Signal output [30] and line codes

Output impedance . . . . . 75 Ω

ECL signals require termination of 75 Ω to -2 V

Max. permitted peak input voltage level . . . . . ± 6 V

The following table shows all line codes (CODE) available from the SF-60, together with their nominal pulse amplitudes in volts (U_a):

CODE	Signal			Return loss	Clock	Notes
	Pulse U_a(V)	No pulse U_a(V)	U_a(V)	≥ 20 dB f_o(MHz)	U_a(V)	
NRZ, RZ	+ 2.37	± 0.2	± 0.2	50	2.37/0	TTL
NRZ, RZ	- 0.8	- 1.8	± 0.1	240	ECL	ECL
AMI	± 2.37	± 0.2	± 0.2	50	2.37/0	
AMI1/1	± 2.37	± 0.2	± 0.2	50	2.37/0	
HDB3	± 2.37	± 0.2	± 0.2	50	2.37/0	ITU-T G.703
$HDB3_{34}$*	± 1	± 0.1	± 0.1	50	2.37/0	ITU-T G.703
B3ZS	± 2.37	± 0.2	± 0.2	50	2.37/0	HDB2
$B3ZS_{44}$**	± 1	± 0.1	± 0.1	50	2.37/0	HDB2
	Signal					
	U_a(V)	U_b(V)	$U_{a,b}$(V)			
CMI	+ 0.5	- 0.5	± 0.05	240	ECL	ITU-T G.703
CMI	+ 2.37	0	± 0.20	50	2.37/0	TTL
CMI	- 0.8	- 1.8	± 0.10	240	ECL	ECL
CMIinv	+ 0.5	- 0.5	± 0.05	240	ECL	
CMIinv	+ 2.37	0	± 0.20	50	2.37/0	TTL
CMIinv	- 0.8	- 1.8	± 0.10	240	ECL	ECL

* for 34368 kbit/s only

** for 44736 kbit/s only

Maximum permitted bit rate for codes

RZ (TTL), NRZ (TTL), AMI, HDB3, B3ZS, CMI (TTL) . . . . . 80 MHz

Return loss in the range 1 kHz to f_o . . . . . ≥ 20 dB

(For f_o refer to table above)

Pulse amplitude setting range for ternary signals and signals with TTL signal levels:

Setting range . . . . . 0.5 to 2.5 V

Step width . . . . . 0.01 V

The "clock" column in the table indicates the clock voltage levels for the particular code.

Pulse masks

AMI, HDB3 and CMI signals . . . . . correspond to ITU-T Rec. G.703

Rise and fall times for

CMI / ITU-T . . . . . < 1.5 ns

AMI, HDB3 and B3ZS . . . . . < 2.5 ns

Intrinsic jitter

Maximum intrinsic jitter, pattern-dependent . . . . . 0.1 ns

referred to the clock signal [34] and measured at 139264 kbit/s for CMI code with PRBS 2^{23}-1.

8.1.2.2 Signal output [29]

Bit rate range . . . . . 2048 ± 1 kbit/s

Output impedance . . . . . 120 Ω, balanced

Max. permitted peak input voltage level (f > 10 kHz) . . . . . ± 12 V

The following table shows the line code (CODE) available from the SF-60, together with the nominal pulse amplitudes in volts U_a (V):

CODE	Signal			Return loss	Clock	Notes
	PULSE U_a(V)	NO pulse U_a(V)	U_a(V)	≥ 18 dB f_o(MHz)	high/low U_a(V)	
HDB3	± 3.00	± 0.3	± 0.3	2.50	2.37/0	ITU-T G.703

Return loss in the range 10 kHz to 2.5 MHz . . . . . ≥ 18 dB

Pulse amplitude settings:

Setting range . . . . . 0.5 to 3.2 V

Step width . . . . . 0.01 V

The "clock" column in the table indicates the clock output voltage levels for the code.

Pulse mask

HDB3 signals . . . . . correspond to ITU-T Rec. G.703

8.1.2.3 Quad output (option BN 2074/00.10)

Three additional signal outputs [31], [32], [33]; output impedance . . . . . .75 Ω
Signal delay between outputs . . . . . 2 bits
Return loss in the range 1 kHz to f_o . . . . . ≥ 15 dB
(f_o see section 8.1.2.1)
Other specifications and codes as in section 8.1.2.1.

8.1.2.4 Clock output [34]

Output impedance . . . . . .75 Ω
ECL signals require termination of 75 Ω to -2 V
Max. permitted peak input voltage level . . . . . .± 6 V
Return loss in the range 1 kHz to f_o . . . . . ≥ 15 dB
(for f_o, see table in section 8.1.2.1)
The clock output [34] is switched depending on the signal code as indicated in the table in section 8.1.2.1.
The modulated clock is available from this output when the jitter modulator is on.

Intrinsic jitter

Maximum intrinsic jitter, with jitter modulator off, measured at clock output [34]
to ITU-T Rec. O.171 . . . . . 0.006 UIpp

8.1.3 Pattern generator

Pseudo-random bit sequences	Period (bits)	Taps at (stage)	Max. zero sequence (bits)	Note
PRBS 6	63	5 + 6	5	
PRBS 7	127	6 + 7	6	
PRBS 9	511	5 + 9	8	ITU-T O.150
PRBS 10 *	1 023	7 + 10	10	ITU-T O.150
PRBS 11	2 047	9 + 11	10	ITU-T O.150
PRBS 15 *	32 767	14 + 15	15	ITU-T O.150
PRBS 17	131 071	14 +17	16	
PRBS 19	524 287	1, 2, 5,19	18	
PRBS 20	1 048 575	3 +20	19	ITU-T O.150
PRBS 20 17th	1 048 575	17 +20	19	US standard
QRSS 20	1 048 575	17 +20	14	US standard ≤ 14 "0" bits
PRBS 23 *	8 388 607			ITU-T O.150
PRBS 29	536 870 911			
PRBS 31	2 147 483 647			Delay measurement

* The PRBS 10, 15 and 23 are normally transmitted inverted, as specified by ITU-T Recs. O.150.
All PRBS can also be transmitted inverted.

Fixed words	Period (bits)
2x8 bits (Ricar sequence)	Corresponds to toggle frequency (internal or external via socket [43])
Bit patterns 1 to 4	1 to 32 freely programmable
Octet	1 to 8 freely programmable
Pattern AIS (AIS insertion)	All ones signal

The programmed bit states can be altered selectively.

8.1.3.1 Internal Ricar sequence switching

Toggle depends on	Passible settings
Frequency	With option BN 2074/00.15 only: As specified in section 8.1.6up to a maximum of 0.2 x bit rate
Fixed frequency	Without option BN 2074/00.15: Frequency range 10 Hz to 500kHz in decade steps of 1, 2 and 5, up to a maximum of 0.2 x bit rate
Bit timing f_B	$m \times 10^{-n} \times f_B$ where m = 1, 2, 5 n= 4, 5, 6, 7, 8

8.1.3.2 Control input [43] for Ricar sequence or external errors

Input switchable for Ricar sequence toggling or for external control of error insertion (cf. section 8.1.4.1).

Max. permitted Ricar sequence toggle frequency . . . . . 0.02 x bit rate

Max. permitted peak input voltage. . . . . 5 V

The sensitivity and input impedance can be set in accordance with the following table:

Input signal	Input impedance		Input voltage required to trigger	
		referred to	1st word	2nd word
Sine and square wave	75 Ω	0 V	- 0.1 to -3 V	+0.1 to +3 V
ECL level	75 Ω	- 2 V	- 1.5 to - 4,5 V	- 0.7 to - 1.1 V
TTL level	approx. 10 kΩ	0 V	0 to +0.8 V	+ 2.4 to + 5 V

8.1.3.3 Pattern trigger output / Input for 2 Mbit/s HDB3 [42]

Pattern trigger

Output of one pulse for each pseudo-random bit sequence or digital word; for words of length 1 or 2 bits, one pulse per 4 bits.

Output impedance . . . . . approx. 75 Ω
Output voltage levels (open circuit) . . . . . ECL
Max. peak input voltage level . . . . . 5 V

2 Mbit/s signal

An external 2 Mbit/s signal can be fed into the PDH chain as a tributary or into the STM1 C12 signal.
The function of socket [42] is switched by selecting EXT 2/xxx or EXTERN 2 as the TX PDH framing from the "Frame Editor" application menu.

Bit rate . . . . . 2048 kbit/s ±50 ppm
Line code HDB3
Input impedance . . . . . 75 Ω
Pulse amplitude required . . . . . ±2.37 V

8.1.4 Error insertion and burst generator

8.1.4.1 Error insertion

Trigger types

Single error . . . . . by keystroke
Error rate, settable . . . . . 1×10^{-8} to 1×10^{-2}
for frame alignment signal (FAS) errors . . . . . 1×10^{-8} to 1×10^{-1}
Mantissa setting range . . . . . 1 to 9
Exponent setting step width 1

For digital signals with frame structures

One bit error is inserted in the FAS of M consecutive frames. This process is repeated after N frames

Setting range for N . . . . . 1 to 11
Number of errors M . . . . . M ≤N

Error insertion external control input [43]

This input can also be used for toggling the Ricar sequence. See section 8.1.3.2 for sensitivity and input impedance.

One error is generated for each positive (rising) signal edge.

Permitted frequency range . . . . . 0 Hz to 10% of bit rate

Error insertion using modulation voltage

The internal modulation voltage from the jitter generator option BN 2074/00.15 can also be used for error insertion.

Max. permitted frequency . . . . . 10% of bit rate
or . . . . . 4.5 MHz

Error types and exponent range

Error type	Reference (R) / Error source (S) [menu text]
Binary error Bit error	R: All transmitted pattern bits S: Bit inversion
Block error	R: All transmitted blocks (block = PRBS - cycle or fixed word) S One binary error per block
Code error AMI	R: All transmitted bits S(CCITT): Two consecutive "1" bits of identical polarity (code error only) S(Code & Ptn): Two consecutive "1" bits of identical polarity (code and pattern error, pos. or neg. "1" bit becomes "0" bit, "0" bit becomes pos. "1" bit)
Code error HDB3, B3ZS (= HDB2)	R: All transmitted bits S(CCITT): Violation bit polarity is changed (code error only) S(Code & Ptn): Pos. or neg. "1" bit becomes "0" bit, "0" bit becomes "1" bit (code and pattern error) S(All Errors): Polarity of a "1" bit (data or violation bit) is changed.
Code error CMI	R: All transmitted bits S(CCITT): Polarity of a "1" bit is changed (code error only) S(Code & Ptn): "0" bit becomes "1" bit, "1" bit becomes "0" bit (code and pattern error) S(Invert. Zero): The states "01" of a "0" bit are changed to the states "10" (States not defined in ITU-T Rec. G.703) S(Altern. One): No change of polarity for 2 clock periods (code and pattern error)

For further error types for STM-1 signals, see section 8.4.1.3.

Frame alignment signal errors for digital signals with frame structures

Frame alignment signal (FAS) error insertion leads to the following errored FAS depending on the bit rate selected:

PCM 1920 (139264 kbit/s):

Frame alignment signal (FAS) to ITU-T Rec. G.751 1111 1010 0000

FAS error insertion is accomplished by inverting the 5th bit.

PCM 480 / PCM 120 (34368 kbit/s / 8448 kbit/s):

FAS to ITU-T Rec. G.742 1111 0100 00

FAS error insertion is accomplished by inverting the 5th or 6th bit.

PCM 30 / PCM 30 CRC (2048 kbit/s / 2048 kbit/s CRC):

FAS to ITU-T Rec. G.704 001 1011

FAS error insertion is accomplished by inverting the 3rd bit.

The error rate displayed is referred to the total number of FAS transmitted.

CRC word errors

CRC word ($C_1C_2C_3C_4$) error insertion is accomplished by inverting the C_2 bit.

8.1.4.2 Burst and micro-interrupt generation

The burst signal is transmitted by keystroke as a single burst with settable duration.

Burst length

The burst length can be set in terms of time or bits:

Setting range	Setting step width
0.4 µs to 13 ms > 13.0 ms to 65 ms 1 kbit to 32 000 kbit	0.2 µs 1.0 µs 1 kbit

Burst signals

Burst signal	Notes
Burst Zero Burst One	Bursts are inserted in the selected bit pattern which is not interrupted.
Micro-interrupts	The duration of the micro-interrupt is the same as the burst duration. Microinterrupts are possible for the following codes: HDB3. B3ZS, AMI

8.1.5 Jitter generator (option BN 2074/00.15)

Fulfils or exceeds the requirements of ITU-T Recommendation O.171.

8.1.5.1 Clock frequency range

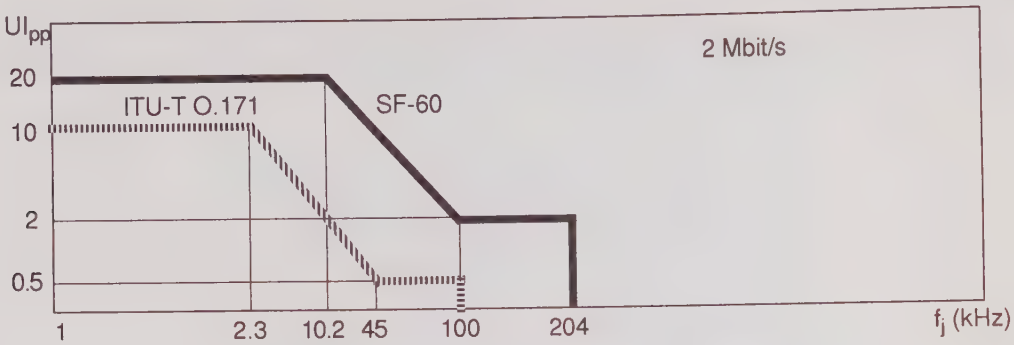
Permissible clock frequency range . . . . . 704 kHz to 175 MHz

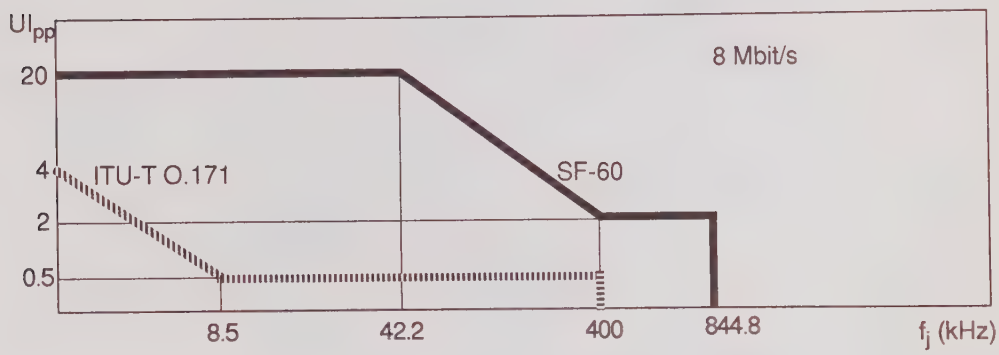
8.1.5.2 Available jitter amplitudes and frequencies

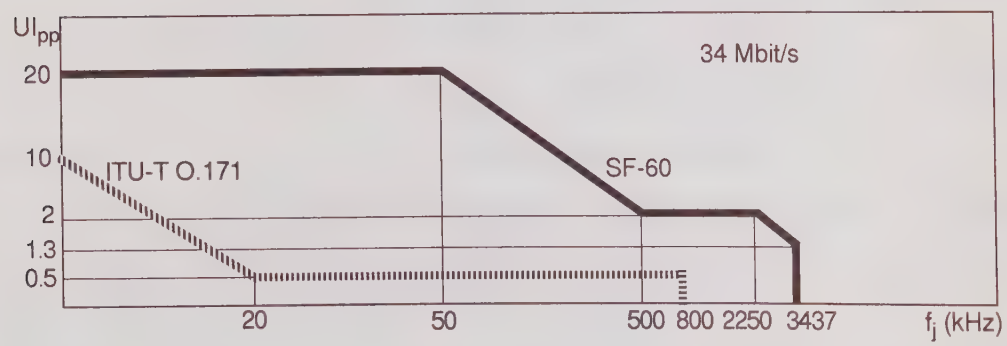
Range	Max. jitter amplitude (UI_{pp})	Step width (UI_{pp})
1	2.49	0.01
2	2.5 to 20	0.1

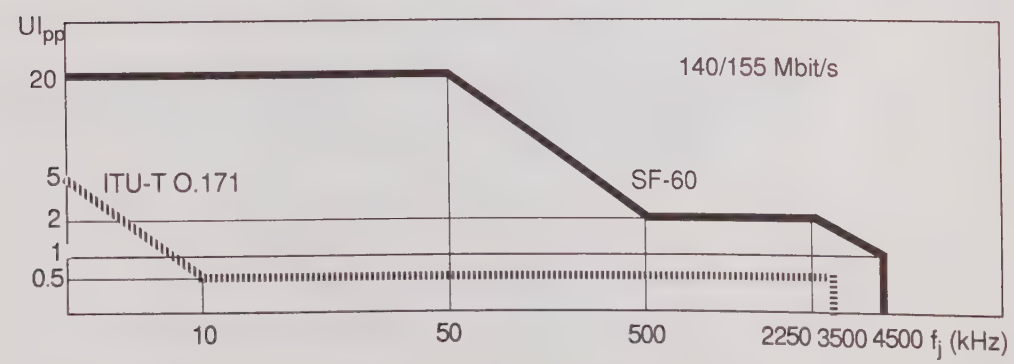
Switching between ranges is automatic and without phase hits.

The SF-60 can process jitter frequencies between 2 Hz and 4.5 MHz and jitter amplitudes from 0 to 20 UI_{pp}. The following graphs indicate the setting values.









fj = jitter frequency in kHz Jitter amplitude in UI_{pp}

Fig. 8-1 Comparison of SF-60 tolerance to jitter values with ITU-T O.171

8.1.5.3 Measurement deviation

Deviation from measured value of jitter amplitude for sinusoidal modulation at 1 kHz, internal or jitter-free clock . . . . . ± 3%

Maximum intrinsic jitter, measured at clock output [34] to ITU-T Recommendation O.171 . . . . . 0.006 UI_{pp}

Jitter frequency response

Maximum variation of jitter amplitude with frequency within the frequency ranges specified in section 8.1.5.2 for a constant amplitude setting; referred to the value at 1 kHz

Measured for 0.5 UI_{pp}:

Jitter frequency	Variations of jitter amplitude
at 2 Hz	-3 dB
10 Hz to 20 Hz	4%
20 Hz to 10 kHz	1%
10 kHz to 300 kHz	2%
300 kHz to 1 MHz	3%
1 MHz to 3 MHz	5%
3 MHz to 4.5 MHz	8%

8.1.5.4 Unmodulated reference clock output [50]

The output is active when the jitter modulator is on. The unmodulated clock signal available from this output is used as a comparison clock for jitter modulated signals.

Output impedance . . . . . approx. 75 Ω

Output voltage levels (open circuit) . . . . . ECL

Max. peak input voltage level . . . . . ± 5 V

8.1.6 Modulation voltage

8.1.6.1 Internal modulation voltage

Min. frequency	Max. Frequency	Step width
2 Hz	1.00 kHz	1 Hz
1.00 kHz	10.0 kHz	10 Hz
10.0 kHz	100 kHz	100 Hz
100 kHz	4 500 kHz	1 kHz

The range is selected automatically

Modulation frequency deviation . . . . . ± 5 ppm

Modulation voltage shape . . . . . sinusoidal

8.1.6.2 External modulation voltage input [56]

Required input signal level (sinusoidal) . . . . . 0 dBm
Max. permitted input signal level . . . . . + 1 dBm
Input impedance . . . . . 75 Ω
Frequency range . . . . . 2 Hz to 4.5 MHz
Return loss at up to 400 kHz . . . . . ≥ 40 dB
at up to 4.5 MHz . . . . . ≥ 20 dB

8.2 Receiver

8.2.1 Inputs and line codes

8.2.1.1 Signal input [36] and line codes

Bit rate range . . . . . 48 to 175000 kbit/s
Input impedance . . . . . 75 Ω
Reflection coefficient for signals in the frequency range 10 kHz to 240 MHz,
to ITU-T Rec. G.703 . . . . . ≥ 20 dB
Permitted pulse amplitude range . . . . . ± 0.05 to 4 V
Max. permitted peak input voltage level . . . . . 5 V

Amplitude and bit rate ranges

CODE	Terminated internally to	Sample threshold	Max. permitted bit rate
NRZ TTL	0 V	auto./step	80 Mbit/s
NRZ ECL	-2 V	-1.3 V	175 Mbit/s
RZ TTL	0 V	auto./step	80 Mbit/s
RZ ECL	-2 V	-1.3 V	175 Mbit/s
AMI	0 V	auto./step	80 Mbit/s
HDB3	0 V	auto./step	80 Mbit/s
B3ZS	0 V	auto./step	80 Mbit/s
CMI TTL	0 V	auto./step	80 Mbit/s
CMI CCITT	0 V	0 V	175 Mbit/s
CMI ECL	-2 V	-1.3 V	175 Mbit/s
CMIinv TTL	0 V	auto./step	80 Mbit/s
CMIinv CCITT	0 V	0 V	175 Mbit/s
CMIinv ECL	-2 V	-1.3 V	175 Mbit/s

Sample threshold setting as per table above:
Automatic (auto) . . . . . 50% of signal amplitude
Stepwise (step) settings . . . . . 30, 40, 50, 60, 70% of signal amplitude

8.2.1.2 Signal input [35] and line code

Bit rate range . . . . . 2048 ± 1 kbit/s
Input impedance . . . . . balanced, 120 Ω
Reflection coefficient for signals in the frequency range 10 kHz to 2.5 MHz . . . . . ≥ 18 dB
Permitted pulse amplitude range . . . . . ± 0.06 to 5 V
Max. permitted peak input voltage level . . . . . ± 6 V

Amplitude and bit rate range

CODE	Sample threshold	Bit rate
HDB3	Automatic / stepwise	2 048 kbit/s

Sample threshold setting as per table above:
Automatic . . . . . 50% of signal amplitude
Stepwise settings . . . . . 30, 40, 50, 60, 70% of signal amplitude

8.2.2 Decoding methods

CODE	Standard decoding		Modified decoding	
HDB3 B3ZS	Decoding using two registers: Register 1, detects state, Register 2 is set		Decoding using one register: Detection and setting in the sam register	
	Register 1 (Ternary value)	Register 2 (Decoded binary value)	Register 1 (Ternary value)	(Decodedbinaryvalue)
HDB3	X00V	0000	X00V	0000
B3ZS	X0V	000	X0V	000
CMI	CMI bit	Decoded binary value	CMI	Decoded binary value
	Positive "1"	"1"	Positive "1"	"1"
	Negative "1"	"1"	Negative "1"	"1"
	"0"	"0"	"0"	"0"
	Inverted "0"	"0"	Inverted "0"	"1"

8.2.2.1 Input signal monitoring

"Input overload" monitor

The d.c. component of the input signal to [36] is monitored
Max. permissible d.c. component . . . . . ± 5.0 V

"No signal" monitor

The input signal is monitored according to the conditions set by the line code or operating mode selected, see section 8.2.2.2.

The input signal is monitored for a minimum amplitude

LED display . . . . . "NO SIGNAL"

"Micro-interrupt" monitor

Micro-interrupts are momentary losses of signal. The input signal is monitored for "0" signal state.

Setting range for micro-interrupts . . . . . 1 µs to 13 ms

Step width . . . . . 1 µs

"No signal (M-int)" monitor

The wait time before the status "No signal (M-int)" is detected can be set to an integer multiple (n) of the programmed micro-interrupt time

Setting range for n . . . . . 1 to 15

Measurement of input voltage level at inputs [36] and [35]

Positive signal amplitude measurement

Measurement range at input [36], unbalanced . . . . . 0.1 to 4.0 V

Measurement range at input [35], balanced . . . . . 0.1 to 5.0 V

Resolution . . . . . 0.1 V

8.2.2.2 Signal conditioning

Equalizer off

CODE	Input signal (V)	
	Nominal amplitude	"No signal" detection
NRZ	2.37	< 0.7
NRZ (ECL)	1.0	< 0.25
RZ	2.37	< 0.7
RZ (ECL)	1.0	< 0.25
AMI	2.37	< 0.7
HDB3	2.37	< 0.7
HDB3 / 120Ω only	3.00	< 0.9
HDB3 / 34 Mbit/s	1.0	< 0.25
B3ZS	2.37	< 0.7
CMI CCITT	0.5	< 0.25 (see fig. 8-2)
CMI ECL	1.0	< 0.25 (see fig. 8-2)
CMI TTL	2.37	< 0.7
CMIinv CCITT	0.5	< 0.25
CMIinv ECL	1.0	< 0.25
CMIinv TTL	2.37	< 0.7

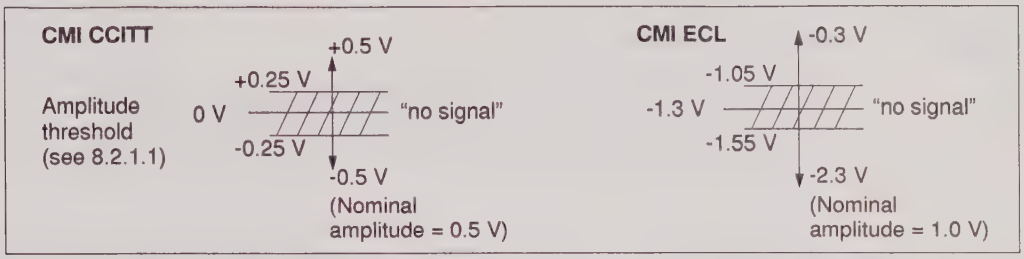


Fig. 8-2 CMI CCITT and CMI ECL code amplitude ranges for detecting "no signal" status

"Auto sense" amplitude-dependent preset

In "Auto sense" mode, the input sensitivity is automatically matched to the input signal amplitude. The input sensitivity setting is made when the "Auto sense" function key is pressed. If the signal amplitude falls below the set amplitude range, the status "no signal" is detected.

Adaptive equalizer on

- 34 Mbit/s equalizer

Equalization at 17.2 MHz . . . . . 0 to 12 dB
Permissible operating range . . . . . 30 to 40 Mbit/s
Line codes . . . . . HDB3, AMI, B3ZS
Signal amplitude setting range (nominal value) . . . . . 0.05 to 4.00 V
If the signal amplitude falls below the set amplitude range, the status "no signal" is detected.

- 140 Mbit/s and 155 Mbit/s equalizer

Equalization at 70 MHz . . . . . 0 to 12 dB
Permissible operating range . . . . . 40 to 160 Mbit/s
Line codes . . . . . .CMI CCITT, CMI inv CCITT
Signal amplitude setting range (nominal value) . . . . . 0.05 to 4.00 V
If the signal amplitude falls below the set amplitude range, the status "no signal" is detected.

8.2.3 Receiver clock

8.2.3.1 Internal clock recovery

Frequency (kHz)	Setting step width (kHz)
48.00 to 999.99	0.01
1 000 to 175 000	1.0

Clock recovery pulling range . . . . . ± 999 ppm

Tolerance to jitter

Jitter amplitude

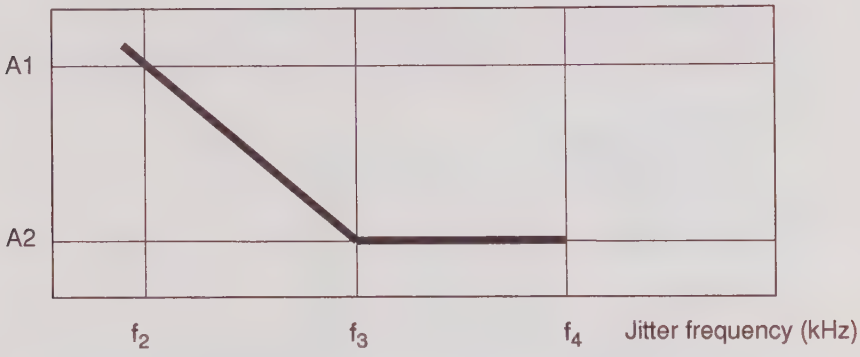


Fig. 8-3 Variation of jitter amplitude with jitter frequency

Bit rate kbit/s	CODE	A1 UI_{pp}	f_2 kHz	A2 UI_{pp}	f_3 kHz	f_4 kHz
2 048	HDB3	10	3	0.25	120	200
8 448	HDB3	10	14	0.25	560	800
34 368	HDB3	10	57	0.25	2 220	3 000
139 264	CMI	10	70	0.20	3 500	3 500
155 520	CMI	10	70	0.20	3 500	3 500

Recovered clock output [46]

Note: The "clock divider" option (see section 8.11.7.2) is required
- for synchronizing the generator of the SF-60 to the clock of a received STM-1 signal or
- if no 2048 kHz system clock is available.

The clock divider must be connected between output [46] and input [41].

Output impedance . . . . . approx. 75 Ω

Output voltage levels (open circuit) . . . . . ECL

Max. peak input voltage level . . . . . 5 V

8.2.3.2 External clock input [37]

Bit rate range . . . . . 1 to 175000 kbit/s
Input impedance . . . . . 75 Ω
Return loss in the frequency range 10 kHz to 240 MHz . . . . . ≥ 20 dB
Required input signal level . . . . . 0.05 to 4 V
Decision threshold . . . . . 50% of signal amplitude
Max. permitted peak input signal level . . . . . 6 V
Digital signal sampling (selectable) . . . . . on rising or falling edge
The d.c. component of the clock signal is monitored;
Max. permitted d.c. voltage component . . . . . ± 5.0 V
Clock signal status is monitored; LED "NO CLOCK" indicates loss of clock signal.

8.2.3.3 Bit rate measurement

The bit rate of the external or recovered clock is measured. If the transmitter is operated from an external clock source, the measurements for the transmitter and generator are made alternately.

Recovered clock

Offset display . . . . . ± 999 ppm
Offset measurement time at > 1 Mbit/s . . . . . 0.5 s
Offset measurement time at 1 Mbit/s . . . . . 1 to 8 s
Error limits at > 1 Mbit/s . . . . . ± 2.0 ppm
Error limits at 1 Mbit/s . . . . . ± 4.0 ppm

External clock

Measurement range (kHz)	Resolution (kHz)
1.000 to 99.999	0.001
100.00 to 999.99	0.01
1 000.0 to 9 999.9	0.1
10 000 to 175 000	1

8.2.4 Signal monitoring

8.2.4.1 Current alarms

The following current alarms are displayed:

Priority	System	Alarm displayed / explanation	LED	s/d
0		LOS / No Signal	NO SIGNAL	s
1		No Clock	NO CLOCK	s
2		LOS (Microint.)		s
3		Microint.	d	
4	SDH	(Frame) AIS LOF / Loss of Frame, ab C-3	AIS	s
5	SDH	OOF-155 / No Frame Sync	NO FRAME	s
6	C-4,C-12,C-3	MS-AIS / Section AIS	AIS	s
7	C-4,C-12,C-3	AU-AIS / Path AIS	AIS	s
8	C-4,C-12,C-3	AU-LOP / AU-Loss Of Pointer	SOH/POH	s
9	C-12	LOM / Loss of Multiframe	SOH/POH	s
10	C-12,C-3	TU-LOP / TU-Loss of Pointer	SOH/POH	s
11	C-12,C-3	TU-AIS	AIS	s
12	PDH	AIS-140M	AIS	s
13	PDH	LOF-140M	NO FRAME	s
14	PDH	AIS-34M	AIS	s
15	PDH	LOF-34M	NO FRAME	s
16	PDH	AIS-8M	AIS	s
17	PDH	LOF-8M	NO FRAME	s
18	PDH	AIS-2M	AIS	s
19	PDH	LOF-2M	NO FRAME	s
20	C-4,C-12,C-3	MS-FERF / Far End Receive Fail	SOH/POH	s
21	C-4,C-12,C-3	HP-FERF / Path Remote Alarm Indication	SOH/POH	s
22	C-12,C-3	LP-FERF	SOH/POH	s
23	C-4,C-12,C-3	HP-UNEQ / Unequipped Indication Signal	SOH/POH	s
24	C-12,C3	LP-UNEQ	SOH/POH	s
25	PDH	RAI-140M / RDI 140 Mbit/s		s
25	PDH	RAI-34M / RDI 34 Mbit/		s
25	PDH	RAI-8M / RDI 8 Mbit/s		s
25	PDH	RAI-2M / RDI 2 Mbit/s		s
26		Patt-AIS / Pattern AIS	AIS	s
27		Patt ..0. / Pattern '0'		s
28		Slip / Pattern slip	NO PATTERN	d
29		No Patt / No pattern sync.	NO PATTERN	s
30		No Alarm		

STM-1 alarms are only evaluated and displayed if the option BN 3017/00.04 is used, PDH alarms with options BN 3017/00.08, BN 3017/00.09 or BN 3017/00.07 only.

s = static alarm with start and stop time (times stored in alarm memory, see section 8.2.4.2)

d = dynamic alarm with start time only.

8.2.4.2 Stored alarms

Alarms occurring are stored in an alarm memory together with their corresponding start and stop times and can be displayed in an alarm table or in a histogram.

Priority	Stored alarm
0	LOS
1	No Clock
2	No Signal (M-Int)
3	Micro-Interrupt
4	(Frame) AIS
	LOF / Loss of Frame, ab C-3
5	No Frame Sync. (OOF)
6	MS-AIS / Section AIS
7	AU-AIS / Path AIS
8	AU-LOP / AU-Loss Of Pointer
9	LOM / Loss of Multiframe
10	TU-LOP / TU-Loss of Pointer
11	TU-AIS
12	AIS-140M
13	LOF-140M
14	AIS-34M
15	LOF-34M
16	AIS-8M
17	LOF-8M
18	AIS-2M
19	LOF-2M
20	MS-FERF / Far End Receive Fail
21	HP-FERF / Path Remote Alarm Indication
22	LP-FERF
23	HP-UNEQ
24	LP-UNEQ
25	(Pattern) AIS
26	Pattern..0.
27	Pattern Slip
28	No Pattern Sync.
29	No Alarm
30	No Line

8.2.5 Evaluated patterns

Patterns as for pattern generator (section 8.1.3) with the exception of the 2x8 bit word (Ricar sequence). If the coupling between transmitter and receiver is disabled, the TX pattern and the RX reference pattern must be set separately.

8.2.5.1 Pattern synchronization

LED "NO PATTERN" indicates loss of pattern synchronization.

Momentary loss of pattern synchronization during a measurement is recorded. These events are stored along with the time of their occurrence and can be recalled as a list at any time (compare section 8.2.4.2 "Stored alarms").

Synchronization of pseudo-random bit sequences

The method used for the synchronization of pseudo-random bit sequences allows measurements of very high error ratios and with long error bursts.

Re-synchronization only occurs if the pattern at the input is identical with but phase-shifted in relation to the internal reference pattern (compare section 8.2.8 "Slip measurement").

Monitoring for high error ratio

Additional "NO PATTERN" LED display for bit error ratio 0.3
over a period of . . . . . 1.9 s

Synchronization of digital words

The method used for the synchronization of digital words allows measurements of very high error ratios.

Re-synchronization only occurs if the detected bit errors are repeated with the same period as the period of the set digital word (compare section 8.2.8 "Slip measurement").

Monitoring for high error ratio

Additional "NO PATTERN" LED display for bit error ratio . . . . . ≥ 0.06
over a period of . . . . . 1.9 s

8.2.6 Error evaluation

8.2.6.1 Error events

The following error events are indicated by LEDs:

- Code error (CODE)
- Bit error (BIT)
- FAS/CRC error
- B1 PARITY error
- B2 PARITY error
- B3 PARITY error

STM-1 errors (B1, B2, B3 parity errors) are evaluated and displayed with the options BN 3017/00.04 (=../00.03 + ../00.05) and BN 3017/00.06 only; PDH errors only with options BN 3017/00.07, BN 3017/00.08 and BN 3017/00.09.

The following error events can be detected and registered:

Event type	Test signal	Error event E
Bit error (binary error)	PRBS and digital word as per 8.2.2.	E: Inversion of a bit state
Block error	PRBS as per 8.2.2.	E: 1 bit error per PRBS cycle or per fixed word
AMI code error	AMI signals	E: Two consecutive pulses of identical polarity (ITU-T O.161)
HDB3 code error*	HDB signals	E: Two consecutive violation bits of identical polarity (ITU-T O.161)
B3ZS code error*	B3ZS signals	E: Two consecutive violation bits of identical polarity (ITU-T O.161)
CMI code error*	CMI signals	E: (1) Two consecutive "1" bits of identical polarity (ITU-T O.161) (2) Two consecutive clock phases without a change of polarity
Frame alignment signal error (FAS)	Framed signals as per ITU-T Recs.	E: Errored FAS word
CRC word error	Framed signals with CRC as per ITU-T Recs.	E. Errored CRC sum

Various evaluation types can be selected for the error types marked with a *; these are specified below.

HDB3 code

As well as the violation errors to ITU-T Recommendation O.161, errors which result from sequences of more than 3 zero bits can be evaluated:

CCITT

Only violation errors as specified by ITU-T Recommendation O.161 (CCITT) are evaluated.

Zero Block N div 4

Only the integer value of the number of consecutive zero bits divided by four is evaluated.

Zero Block N - 3

Only the number of consecutive zero bits minus three is evaluated.

CCITT & ZB N div 4

The integer value of the number of consecutive zero bits divided by four is added to the ITU-T violation errors as per ITU-T O.161.

CCITT & ZB N - 3

The number of consecutive zero bits minus three is added to the ITU-T violation errors as per ITU-T O.161.

Code B3ZS

As well as the violation errors to ITU-T Recommendation O.161, errors which result from sequences of more than 2 zero bits can be evaluated:

CCITT

Only violation errors as specified by ITU-T Recommendation O.161 are evaluated.

Zero Block N div 3

Only the integer value of the number of consecutive zero bits divided by three is evaluated.

Zero Block N - 2

Only the number of consecutive zero bits minus two is evaluated.

CCITT & ZB N div 3

The integer value of the number of consecutive zero bits divided by three is added to the ITU-T violation errors as per ITU-T O.161.

CCITT & ZB N - 2

The number of consecutive zero bits minus two is added to the ITU-T violation errors as per ITU-T O.161.

CMI code

CCITT

Error evaluation as described in the table, section 8.2.6.1.

Invert.Zero

The status where the positive edge of the signal lies at the center of the bit (inverted zero bit) is evaluated as an error (status is not described in ITU-T Rec. G.703)

CCITT & Invert.Zero

The error described under "Invert.Zero" as well as the ITU-T errors are evaluated.

External error input [49]

Input impedance and sensitivity are switchable:

TTL or HCMOS

Input impedance	approx. 10 kΩ
Permissible input voltage range	-0.5 to +5.5 V

Required input voltages, square wave:

No pulse	< 0.8 V
Pulse	> 2.0 V
Minimum pulse length	15 ns
Maximum count rate	15 MHz

ECL

Input impedance	75 Ω
Terminated to	-2 V
Permissible input voltage range	-4.5 to -0.7 V

Required input voltages, square wave:

No pulse	< -1.5 V
Pulse	> -1.1 V
Minimum pulse length	2.8 ns
Maximum count rate	175 MHz

8.2.6.2 Event selection

Event type	Evaluation			Counter			
	Count	Ratio	Other	1	2	3	Fixed
Code error	•	•		•	•	•	
Bit error	•	•		•	•	•	
Block error	•	•				•	
External error	•				•		
FAS word error [2]	•	•				•	
FAS bit error [3]	•	•				•	
CRC word error [4]	•	•			•		
CRC bit error [4]		•		•			
E bit [5]	•	•				•	
Slip [6][7]	•			•			
Delay [6]			ms	•			
Stuffing rate [1]			kbit/s		•		
B1 parity [3]	•	•					•
B2 parity [3]	•	•					•
B3 parity [3]	•	•					•
LP-BIP resp. LP-B3 [8]	•	•					•
Pointer increment [3]	•						•
Pointer decrement [3]	•						•
Pointer Σ [3]	•						•
HP-FEBE [3]	•	•					•
LP-FEBE [8]	•	•					•

1) Stuffing rate for all frames except PDH 2/8, 8/34, 34/140
2) For all frames
3) For STM-1 only
4) For PCM 30 CRC only
5) For PCM 30/PCM30 CRC only
6) Not a start/stop measurement
7) Start / stop measurement from software version 1.004 onwards
8) STM-1 C-12, C-3 only
9) For frames of an hierarchical stage only

Error output / Output for 2 Mbit/s HDB3 [48]

The events registered by counters 1 to 3, the tributary clock or a 2 Mbit/s signal (from the demultiplexer chain or from the STM1-C12 signal) can be selected for output from socket [48] (selection in menu "RX Setting", parameter "Trig. Output [48]").

Output impedance . . . . . approx. 75 Ω
Output voltage levels (open circuit) . . . . . ECL
Max. permitted peak input voltage . . . . . 5 V

2 Mbit/s signal HDB3 [48]

Bit rate . . . . . 2048 kbit/s ± 50 ppm
Code HDB3
Input impedance . . . . . 75 Ω
Pulse amplitude . . . . . ± 2,37 V

8.2.6.3 Measurement times and result display

Measurement intervals

Interval time setting

Either in four fixed ranges:

1. Range ss.s . . . . . 0.2 s to 99.9 s
2. Range mm.ss . . . . . 0 m 01 s to 99 m 59 s
3. Range hh.mm . . . . . 0 h 01 m to 99 h 59 m
4. Range dd.hh . . . . . 0 d 01 h to 99 d 23 h

Measurement sequence

Measurement start

Manual . . . . . START key
Timer . . . . . programmed time

Measurement end

Manual . . . . . STOP key
Timer . . . . . end of programmed gate time

Measurement cycles

Single measurement
Repeat N times
Setting range for N . . . . . 1 to 99
Repetitive (repeat continuously)

Measurement result display

The results are displayed as absolute error count or error ratio.
Absolute error count display:
In the range 0 to 9999999 . . . . . 7-digit
1.00×10^{7} to 9.99×10^{19} . . . . . mantissa and exponent display

Error ratio display
In the range 1.00 to 1.00×10^{-16} . . . . . mantissa and exponent display
The errors detected are referred to the elapsed time.

Result storage

From software version 3.001 onwards, results and alarms are stored in a common memory and can be displayed as a graphic (histogram display).

8.2.6.4 Evaluation to ITU-T Recommendation G.821

Determination of:

- Error free seconds (EFS)
- Errored seconds (ES)
- Severely errored seconds (SES)
- Degraded minutes (DM)
- Unavailable seconds (US)

The threshold error ratio parameters required for the evaluation can be set:

Severely errored seconds (SES) . . . . . 1×10^{-5} to 1×10^{-2}

Degraded minutes (DM) . . . . . 1×10^{-7} to 1×10^{-2}

Mantissa setting range . . . . . 1 to 9

Exponent setting step width 1

Minimum measurement time setting . . . . . .1 minute

Further measurement and printout of intermediate results can be activated for the G.821 measurement in addition to the normal printer operation.

Interval times, switchable separately . . . . . 5, 10, 15, 30 m; 1, 2, 4, 8, 24 h

8.2.6.5 Evaluation to ITU-T Recommendation G.826 (Option BN 3017/00.52)

Evaluation to Recommendation G.826 is always applied to the highest hierarchy level of the framed signal.

Only the forward channel path is assessed for PDH signals.

Either the forward or the backward channel path can be evaluated for SDH signals.

The following are determined:

- Errored seconds(ES)
- Severely errored seconds (SES)
- Errored blocks (EB)
- Error free seconds (EFS)
- Unavailable seconds (US)
- Path evaluation: ACCEPTED / UNCERTAIN / REJECTED:

The threshold parameters required for the evaluation can be set in user define mode:

Severely errored second (SES) . . . . . .1 to 65534

For path evaluation:
Thresholds S1, S2, with S1 ≤ S2 (in "User S1_S2" mode):

Errored seconds(ES) . . . . . 0 to 9999999

Severely errored seconds (SES) . . . . . .1 to 99999

Errored blocks without SES (BBE, background block errors). . . . . 1 to 999999999

Threshold setting step width 1

Minimum settable measurement time. . . . . .1 minute

Recommended minimum measurement time. . . . . 1 hour

8.2.7 Delay measurement

The instrument measures the delay between the transmitter and receiver sections by means of comparing characteristic sequences in the pseudo-random sequence used. The measurement range and measurement time depend on the bit rate and the selected pattern (see following table).

The center of the available range is indicated in the display.

Result display . . . . . floating point, 4-digit

Result range, unframed signals . . . . . 1µs to 9.99 s

framed signals . . . . . 100 µs to 9.99 s

Minimum time between consecutive measurements . . . . . > 0.5 s

or . . . . . > twice the maximum measurement range

Maximum time between consecutive measurements . . . < 4 x maximum measurement range

PRBS 2^n-1 n =	Max. measurable delay (ms) at a bit rate of (Mbit/s)							
	0.06	0.7	2	8	34	139	155	175
6	1.00	—	—	—	—	—	—	—
7	2.00	—	—	—	—	—	—	—
9	8.00	0.72	0.25	—	—	—	—	—
10	16.0	1.40	0.50	—	—	—	—	—
11	32.0	2.90	1.00	0.24	—	—	—	—
15	500	46.0	16.0	3.80	0.95	0.23	0.21	—
17	2 000	180	64.0	15.0	3.80	0.94	0.84	0.74
19	8 000	740	250	62.0	15.0	3.70	3.40	2.90
20	9 999	1 400	500	120	30.0	7.50	6.80	5.90
23	—	9 999	4 000	990	240	60.0	54.0	47,0
29	—	—	—	9 999	9 999	3 800	3 500	3 000
31	—	—	—	—	—	9 999	9 999	9 999

8.2.8 Slip measurement

Bit slips which occur are detected in magnitude and direction. A bit slip between the input pattern and the reference pattern always results in re-synchronization of the reference pattern.

Measurement range . . . . . < 0.5 x bit pattern period

Resolution . . . . . 1 bit

Max. measurement time . . . . . 100 ms

additionally, for PRBS . . . . . < 2 pattern periods

for digital words (depending on pattern) . . . . . < 18 x word length

8.2.9 Automatic measurement: Maximum tolerance to jitter (MTJ)

(Only available with option BN 2074/00.15 fitted)

For specifications of the option BN 2074/00.15, see section 8.1.5

After starting the measurement, the jitter amplitude of the digital signal is altered by set increments until the bit error meter detects that the pre-set threshold has been exceeded. The amplitude one increment below this value is output as the tolerance to jitter result.

Error source:

- Errors in received digital signal (bit, code, CRC word errors)
- External errors (socket [49])

Error threshold . . . . . 0 to 999 errors

The events "No pattern" / "No frame", "AIS" and "Micro-interrupt" are considered as exceeding the threshold.

The jitter frequencies at which measurement is made can be determined by the user:

- As 10 freely programmable frequency points

in the range . . . . . .2 Hz to 4.5 MHz

- As logarithmically spaced frequency points between a start frequency and a stop frequency:

Start frequency range . . . . . 2 Hz to 4.5 MHz

Stop frequency range . . . . . .2 Hz to 4.5 MHz

Steps (number of measurement points) per decade . . . . . 2 to 9

Settling time . . . . . 0.1 to 99.9 s

Record . . . . . .as table of values printout

For further information refer to section 3.3.6.1 "Automatic max. tolerable jitter (MTJ) measurement.

8.3 PDH frame generator

8.3.1 Frame structures

The following frame structures are available:

64 kbit/s to 140 Mbit/s (MUX/DEMUX chain) . . . . . BN 3017/00.07

140 Mbit/s . . . . . BN 3017/00.08

64 kbit/s to 34 Mbit/s . . . . . BN 3017/00.09

Bit rate (kbit/s)	Frames to Recommendation:	Remarks	Options required
2 048	ITU-T G.704	System PCM 30,without CRC	BN 3017/00.09 or /00.07
2 048	ITU-T G.704	System PCM 30,with CRC	BN 3017/00.09 or /00.07
8 448	ITU-T G.742	System PCM 120	BN 3017/00.09 or /00.07
34 368	ITU-T G.751	System PCM 480	BN 3017/00.09 or /00.07
139 264	ITU-T G.751	System PCM 1920	BN 3017/00.08 or /00.07

If framed operation is set, a check must be made that the correct interface conditions have been selected. The interface selected as initialization interface for the instrument will be set as default

8.3.2 Device configurations

The MUX/DEMUX chain (BN 3017/00.07) allows generation and evaluation of complete, framed PDH signals. The tributary and system (transmission) bit rates can be freely selected.

The output signal from the MUX chain can be mapped into an appropriate SDH container. The signal demapped from the SDH container can be fed to the DEMUX chain and then analysed further.

The following table shows some examples of possible instrument configurations:

Application		Transmitter setting		Receiver setting	
TX bit rate (kbit/s)	Selection	Bit rate (kbit/s)	Frames	Bit rate (kbit/s)	Frames
2 048	Framed Error Test	2 048	on	2 048	on
2 048	MUX Test	64	off	2 048	on
2 048	DEMUX Test	2 048	on	64	off
34 368	Framed Error Test	34 368	on	34 368	on
34 368	MUX Test	2 048	off	34 368	on
34 368	DEMUX Test	34 368	on	2 048	off
34 368	Framed Error Test	34 368	on	34 368	on
34 368	MUX Test	8 448	off	34 368	on
34 368	DEMUX Test	34 368	on	8 448	off
139 264	Framed Error Test	139 264	on	139 264	on
139 264	MUX Test	34 368	off	139 264	on
139 264	DEMUX Test	139 264	on	34 368	off
139 264	Framed Error Test	139 264	on	139 264	on
139 264	MUX Test	2 048	off	139 264	on
139 264	DEMUX Test	139 264	on	2 048	off

The selected applications Framed Error Test, MUX Test and DEMUX Test given in the table apply to the following types of device under test:

Framed Error Test: Digital exchanges

MUX Test: Multiplexers

DEMUX Test: Demultiplexer

8.3.3 Frame structure

Time slots can be selected in all PCM frame structures. These may be voice or data channels in primary rate systems or tributary channels in a stuffing multiplex system.

8.3.4 Generator

8.3.4.1 Signals for bit error measurements

Bit patterns as specified in section 8.1.3;

1. transmitted . . . . . in all timeslots
. . . . . (framed pattern to ITU-T O.150)
2. transmitted . . . . . in the selected timeslot
3. transmitted . . . . . in all time slots identically

External 2 Mbit/s signal [42]

Bit rate . . . . . 2.048 Mbit/s ± 50 ppm
Line code HDB3
Input impedance . . . . . 75 Ω
Pulse amplitude required . . . . . ± 2.37 V

8.3.4.2 Idle channel signals

The non-selected time slots can be occupied by one of the following signals:

For PCM 1920, PCM 480, PCM 120:

- All ones
- Complete structured signal with PRBS 6 in all 64 kbit/s channels

For PCM 30 / PCM 30 CRC:

- Settable octet
- PRBS 6 (default setting)

8.3.4.3 Frame alignment signals

The frame alignment signals (FAS) conform to ITU-T Recommendations G.751, G.742 and G.704.

8.3.4.4 Frame bit modifications

The following bits can be statically programmed:

PCM 1920 (G.751) . . . . . bits 13, 14, 15 and 16 of the FAS
PCM 480, 120 (G.751, G.742). . . . . .bits 11 and 12 of the FAS
PCM 30 / PCM 30 CRC (G.704) . . . . . bits 3 to 8 of the NFAS

The following bits can be dynamically programmed:

PCM 30 / PCM 30 CRC (G.704) . . . . . bits 4 to 8 of the NFAS (S_a4 to S_a8)

Any one of the four bits S_a4 to S_a8 can be selected and occupied with a freely programmable 8 bit pattern

For signals with multiframes, frame 1 in time slot 16 can be occupied by a freely programmable 8 bit pattern; frames 2 to 15 can be occupied with a further freely programmable 8 bit pattern.

8.3.4.5 CRC calculation

Parity calculation

The instrument calculates the CRC sum as per ITU-T Rec. G.704 when "64k/2m CRC" (PCM 30 CRC) is selected, and inserts the resulting bits into the appropriate bit positions of the pulse frame.

The selection "PCM30 CRC" or "PCM30" can be set separately for the text and filler channels.

8.3.4.6 Stuffing method to ITU-T G.742 or G.751

The bit rates of the upper and lower systems have a fixed relationship.

Stuffing occurs at a nominal stuffing rate (exception: multiplexing the external 2 Mbit/s signal).:

Upper system bit rate (kbit/s)	ITU-T	Stuffing ratio	Stuffing rate (kbit/s)	Lower system offset (ppm)
8 448	G.742	0.42424	4.2264	± 30
34 368	G.751	0.43575	9.7499	± 20
139 264	G.751	0.41912	19.935	± 15

8.3.4.7 Alarms

With the exception of AIS, the alarm states for all frames are fixed at "Alarm Off".

AIS can be set separately for the upper system and the selected channel/lower system via the menu.

8.3.5 Receiver

8.3.5.1 Frame alignment signal (FAS) errors

Simultaneous analysis of FAS errors at all hierarchy levels of the selected test path.

Errored FAS words are evaluated. The error ratio is referred to the total number of FAS words received during the measurement interval.

The error ratio corresponds to an equivalent bit error rate.

8.3.5.2 Frame bit evaluation

The following bits are evaluated and displayed:

PCM 1920 (G.751) . . . . . bits 13, 14, 15 and 16 of the FAS

PCM 480, 120 (G.751, G.742) . . . . . bits 11 and 12 of the FAS

PCM 30 / PCM 30 CRC (G.704) . . . . . bits 3 to 8 of the NFAS (A bit, S_a4 to S_a8)

Any one of the bits S_a4 to S_a8 can be selected for displaying the pattern of up to 8 bits.

The E bits can be used for error counting purposes.

8.3.5.3 CRC evaluations (2 Mbit/s CRC)

Errored CRC words are counted (display: "CRC W"). The error ratio is referred to the total number of CRC words received during the measurement interval (CRC word error ratio in %).

The CRC bit error ratio (display: CRC B) can be calculated from the CRC word error ratio, selected in the "Measure" menu.

The number of E bit errors can also be converted to a bit error rate.

8.3.5.4 Alarm evaluation

AIS and No AIS detection

At 2048 kbit/s:

The condition specified in the table below must occur in 2 consecutive double frames (2x 512 bits) .

At 8448, 34368 and 139264 kbit/s:

The condition specified in the table below must occur in 2 consecutive frames.

Upper system Bit rate kbit/s	ITU-T	Number of zeros for **AIS** detection:	Number of zeros for **No AIS** detection
2 048	G.707	≤ 2	≥ 3
8 448	G.742	≤ 4	≥ 5
34 368	G.751	≤ 4	≥ 5
139 264	G.751	≤ 5	≥ 6

8.3.5.5 Evaluation of test signals for bit error measurements

1. Evaluated . . . . . for all timeslots

. . . . . (framed pattern to ITU-T O.150)

2. Evaluated . . . . . in the selected timeslot

8.3.5.6 Measurement of the stuffing bit rate

Display in . . . . . ppm
Display range . . . . . 3 digits
Simultaneous evaluation of frequency offset on all hierarchy levels.

8.4 SDH frame generator

The following describes the characteristics of options BN 3017/00.03 "STM-1 C-12" (2 Mbit/s mapping), BN 3017/00.05 "STM-1 C-4" (140 Mbit/s mapping) und BN 3017/00.06 "STM-1 C-3" (34 Mbit/s mapping).

8.4.1 STM-1 for 2, 34, 140 Mbit/s, options BN 3017/00.03 (2 Mbit/s mapping), 3017/00.05 (140 Mbit/s mapping) and 3017/00.06 (34 Mbit/s mapping)

The following frame structures are available:

Bit rate (kbit/s)	Frame to Recommendation:	Remarks
155 520	ITU-T G.707 ITU-T G.708 ITU-T G.709	System STM-1 140 Mbit/s, C-4 mapping 2 Mbit/s mapping via VC-4 34 Mbit/s mapping via VC-4

If framed operation is set, a check must be made that the correct interface conditions have been selected. The interface selected as initialization interface for the instrument will be set as default.

8.4.1.1 Device configurations

The following table shows the possible instrument configurations:

Application		Transmitter setting		Receiver setting	
TX bit rate (kbit/s)	Selection	Bit rate (kbit/s)	Frames	Bit rate (kbit/s)	Frames
155 520	Framed Error Test	155 520	on	155 520	on
155 520	MUX Test	139 264[1]	off	155 520	on
155 520	MUX Test	34 368[2]	off	155 520	on
155 520	MUX Test	2 048[3]	off	155 520	on
155 520	DEMUX Test	155 520[1]	on	139 264	off
155 520	DEMUX Test	155 520[2]	on	34 368	off
155 520	DEMUX Test	155 520[3]*	on	2 048	off

1) 140 Mbit/s mapping/demapping

2) 34 Mbit/s mapping/demapping

3) 2 Mbit/s mapping/demapping

The selected applications Framed Error Test, MUX Test and DEMUX Test given in the table apply to the following types of device under test:

Framed Error Test: Exchange/Transmission, D.U.T. type "exchange"
tributary either 139 264 kbit/s or 3 x 34 368 kbit/s or 63 x 2 048 kbit/s

MUX Test: Multiplexers

DEMUX Test: Demultiplexers

8.4.1.2 Frame structure

The STM-1 frame is formed from the following sections as per ITU-T Rec. G.709:

- Section overhead SOH
- AU-4 pointer AU-4-PTR (AU-4 pointer + VC-4 = AU-4)
- Path overhead POH
- Container C-4 (C-4 + POH = VC-4)

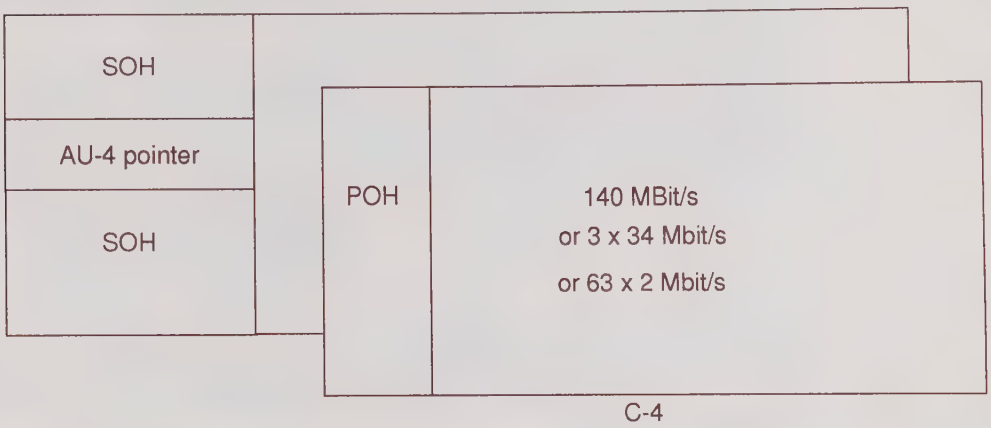


Fig. 8-4 STM-1 frame structure

The C-4 container is occupied with a 139264 kbit/s tributary or with 3 x 34 kbit/s tributaries in TU-3 or with 63 x 2048 kbit/s tributaries in TU-12. The 2048 kbit/s tributary mapping may be asynchronous or bit synchronous.

The AU-4 pointer in the SOH indicates the start of the VC-4.

2048 kbit/s multiframe

A multiframe structure formed from four frames to ITU-T G.709 is used as payload. Synchronization is by means of bits 7 and 8 of byte H4 in the VC-4 POH.

8.4.1.3 Generator

Signals for bit error measurements

For 2 and 34 Mbit/s mapping, one or all channels can be occupied with the same bit pattern from the pattern generator and any remaining channels filled with an idle channel pattern (PRBS 6, all zeros, all ones)

Bit patterns and idle patterns are mapped into C-12 or C-3 just like 2 or 34 Mbit/s tributaries. The test and idle channels have the complete TU structure specified in ITU-T G.709.

For 140 Mbit/s mapping, a pattern to ITU-T G.709 as specified in section 8.1.3 is mapped into a C-4.

The test signal from the pattern generator can also be inserted into one or more specified bytes of the SOH or VC-4 POH. This permits bit error measurements to be made via the SOH and VC-4 POH channels.

If the MUX/DEMUX chain (BN 3017/00.07) is used, fully structured test and fill patterns can be generated and mapped.

Pointers

The AU-4 pointer is fixed at 522, the TU-3 pointer is fixed at 595.
The VC-4 begins (J1) in line 1 column 10
The TU-12 pointers are fixed at 0 for asynchronous mapping. They are variable for synchronous mapping.

Frame alignment signals

The STM-1 frame alignment signals (FAS/NFAS) correspond to ITU-T Recommendation G.708:
11110110 11110110 11110110 00101000 00101000 00101000

Parity formation

To ITU-T Recommendation G.708:

RS-BIP (B1):
BIP-8, even parity,
formed over the entire nth frame after scrambling
inserted in the nth frame before scrambling

MS-BIP (B2):
BIP-24, even parity,
formed over the entire n th frame except the first three rows of the SOH
inserted in the n+1 th frame before scrambling

HP-BIP (B3):
BIP-8, even parity,
formed over VC-4
inserted in the n+1 th frame before scrambling

LP-BIP (B3):
BIP-8, even parity,
formed over VC-3
inserted in the n+1 th frame before scrambling
Formed for all 3 VC-3s.

LP-BIP (V5):
BIP-2, even parity
Formed over the VC-12 container of the n th multiframe
Inserted into the overhead (V5) of the n+1 th multiframe
Formed for all 63 VC-12s.

Scrambling

7 bit polynomial to ITU-T Recommendation G.709:
Polynomial . . . . . $1 + x^6 + x^7$
The first row of the SOH is not scrambled
The scrambler can be disabled

Stuffing method

To ITU-T Recommendation G.709:
The bit rates of the upper and lower systems are independent of each other.

140 Mbit/s mapping

Lower system offset (139264 kbit/s)
within the range. . . . . ± 50 ppm
Setting step width . . . . . 5 ppm

34 Mbit/s mapping

Lower system offset (34368 kbit/s)
within the range. . . . . ± 60 ppm
Setting step width . . . . . 5 ppm

2 Mbit/s mapping

Asynchronous operation with variable positive stuffing (S2) and fixed negative stuffing with a ratio of 3/7 (S1):
Lower system (2048 kbit/s) offset
within the range . . . . . ±100 ppm
Setting step width . . . . . 5 ppm
Bit synchronous operation with TU-12 pointer operations (increment, decrement, no NDF):
Lower system (2048 kbit/s) offset
within the range. . . . . ±30 ppm
Setting step width . . . . . 5 ppm

Alarms

Alarm Insertion	possible for	Generation		
		Static	Repetitive Cycle duration 0.2 - 0.9 s	
			Frame no.	Time
			0 to 999	0.1 to 9.8 s
LOS	C-4, C-12, C-3	•	–	–
LOF	C-4, C-12, C-3	•	•	•
MS-AIS	C-4, C-12, C-3	•	•	•
AU-LOP	C-4, C-12, C-3	•	•	•
LOM	C-12	•	•	•
TU-LOP	C-12, C-3	•	–	–
AU-AIS	C-4, C-12, C-3	•	•	•
TU-AIS	C-12, C-3	•	–	–
MS-FERF	C-4, C-12, C-3	•	•	•
HP-FERF	C-4, C-12, C-3	•	•	•
LP-FERF	C-12, C-3	•	–	–
HP-UNEQ	C-4, C-12, C-3	•	•	•
LP-UNEQ	C-12, C-3	•	–	–
Pattern AIS	C-4, C-12, C-3	•	•	•

When alarm insertion is selected, error insertion is always OFF.

Alarm insertion

The following table shows which bits are inverted for the various types of alarm insertion.

Alarm	Insertion into Byte / bit number	Hex value before / after alarm insertion
MS-AIS	K2 6 to 8 = '1'	00 07
AU-LOP	H1 NDF enabled (1 to 4 inverted)	6A 9A
LOM	H4 sequence is inverted	FC, FD, FE, FF inverted
TU-LOP*	V1 NDF enabled (1 to 4 inverted) (TU-12)	
AU-AIS	Container C4 set to '1'	POH/data channels: FF
TU-AIS	TU set to '1' (TU-12, TU-3)	
MS-FERF	K2 6 and 7 = '1'	00 06
HP-FERF	G1 5 = '1'	07 0F
LP-FERF*	V5 8 = '1' (VC-12)	
HP-UNEQ	C2 1 to 8 = '0'	00
LP-UNEQ*	V5 6 = '0' (L1 to L3 = '0') (VC-12)	

* Alarm insertion for TU-3: TU-LOP (H1 byte of VC-3-POH: NDF enabled), LP-FERF (G1 byte of VC-3-POH: Bit 8='1'), LP-UNEQ (C2 byte of VC-3-POH: bits 1 to 8='0')

SOH and VC-4 POH overhead generation

Standard overhead (hex)

	SOH									VC-4-POH
	1	2	3	4	5	6	7	8	9	10
1	A1 F6	A1 F6	A1 F6	A2 28	A2 28	A2 28	C1 00	-- AA	-- AA	J1 00
2	B1 XX	-- FF	-- FF	E1 00	-- FF	-- FF	F1 00	-- FF	-- FF	B3 XX
3	D1 FF	-- FF	-- FF	D2 FF	-- FF	-- FF	D3 FF	-- FF	-- FF	C2 **
4	H1 6A	Y 9B	Y 9B	H2 0A	-- FF	-- FF	H3 00	H3 00	H3 00	G1 07
5	B2 XX	B2 XX	B2 XX	K1 00	-- FF	-- FF	K2 00	-- FF	-- FF	F2 00
6	D4 FF	-- FF	-- FF	D5 FF	-- FF	-- FF	D6 FF	-- FF	-- FF	H4 ##
7	D7 FF	-- FF	-- FF	D8 FF	-- FF	-- FF	D9 FF	-- FF	-- FF	Z3 00
8	D10 FF	-- FF	-- FF	D11 FF	-- FF	-- FF	D12 FF	-- FF	-- FF	Z4 00
9	Z1 00	Z1 00	Z1 00	Z2 00	Z2 00	Z2 00	E2 00	-- FF	-- FF	Z5 00

XX: inserted by parity formation (B1, B2, B3)
**: 12 for C-4, 02 for C-12, 04 for C-3
= FF for C-3, C-4, FC, FD, FE, FF (sequence across 4 frames) for C-12

1. Load bytes with static bits (simultaneous):

	SOH									VC-4-POH
	1	2	3	4	5	6	7	8	9	10
1							C1	X	X	J1
2				E1			F1			
3										C2
4										G1
5				K1			K2			F2
6										
7										Z3
8										Z4
9	Z1	Z1	Z1	Z2	Z2	Z2	E2			Z5

X = Bytes have no fixed labels; shown by "--" in the display.

In addition to the bytes shown above, **one** other byte except B1, B2, B3, K1, K2, D1 to D12 can be loaded statically (e.g. a further A1 byte)

2. Load bytes with a 64 byte sequence

   Any byte in the SOH or VC-4 POH (except B1, 3 x B2, B3) can be loaded with a 64 byte sequence. The sequence is transmitted in the selected byte of 64 consecutive frames.

3. Load bytes with dynamic pattern from pattern generator or V.11 interface

   Any one byte per frame in the SOH or VC-4 POH (except B1, 3 x B2, B3) can be loaded with the TX pattern or a pattern from the V.11 interface (64 kbit/s), or
   Two bytes per frame (K1, K2) can be loaded with the TX pattern or a pattern from the V.11 interface (128 kbit/s), or
   Three bytes per frame (D1 to 3, 3 x Z1, 3 x Z2 or Z 3 to 5) can be loaded with the TX pattern or a pattern from the V.11 interface (192 kbit/s), or
   Nine bytes per frame (D4 to 12) can be loaded with the TX pattern or a pattern from the V.11 interface (576 kbit/s)

   Dynamic occupancy overwrites static occupancy and occupancy with a sequence.

VC-12 POH overhead generation

Standard VC-12 POH

V5 = XX00 0100 (VC-12 A for asynchronous operation)
V5 = XX00 0110 (VC-12 S for bit-synchronous operation)
Available for static loading:

RFI	bit 4
Signal label (L1, L2, L3)	bits 5 to 7
LP-FERF	bit 8
LP-FEBE fixed at "0"	bit 3
LP-BIP error formed internally	bits1and 2

LP-FEBE and LP-BIP errors can be influenced using the error insertion facilities.

VC-3 POH overhead generation

Standard VC-3-POH

POH bytes	Test channel*	Fill channel
J1	00	00
B3	XX	XX
C2	04	04
G1	00	00
F2	00	00
H4	FF	FF
Z3	00	00
Z4	00	00
Z5	00	00

* The VC-3-POH of the test channel can be edited. The POH of the fill channel is fixed.

Error insertion in STM-1 signals with frame structure

This is in addition to the error insertion specified in section 8.1.4

Error Insertion		Generation					
Type	for	Single	Rate	M in N	Frequency	External	N frames
FAS	C4,C12,C3	•	BER	•	•	•	
B1*	C4,C12,C3	• (x2)	BER	•	•	•	
B1inv*	C4,C12,C3	• (x16)	FRM	•	•	•	
B2*	C4,C12,C3	• (x4)	BER	•	•	•	
B3	C4,C12,C3	•	BER	•	•	•	
LP-BIP	C12A,C3	•	BER	•	•	•	
HP-FEBE	C4,C12,C3	•	BER	•	•	•	
LP-FEBE	C12A,C3	•	BER	•	•	•	
AU-NDF	C4,C12,C3	•	FRM	•	•	•	
TU-NDF	C12A,C3	•	FRM	•	•	•	
STM Byte	C4,C12,C3	•	FRM	•	•	•	
STM Byte MF	C12	•	FRM	•	•	•	•
STM Slip	C4,C12,C3	•	FRM		•	•	•

*For single error insertion, the number of B1 or B2 errors generated is 2 (B1), 16 (B1 inv) or 4 (B2) times the number of errors inserted.
For error insertion of one error rate, the error rate displayed is exactly the one which has been inserted. This is important for sensor tests e.g.

BER = Equivalent BER

FRM = Division ratio referred to frame clock

STM slip operates in the 1st A1 byte of the SOH and leads to a re-synchronization of the frame.

From 1 to 8 bits per byte can be errored (inverted) for error types STM byte and STM byte MF.

Error insertion in any bit of the frame

After scrambling by specifying the row, column and bit.

Error insertion in the frame alignment signal (FAS = A1, A2 bytes)

FAS to ITU-T Rec. G.708:

11110110 11110110 11110110 00101000 00101000 00101000

FAS after error insertion:

11110110 11110110 11110111 00101000 00101000 00101000

Error insertion in the parity bytes

After scrambling:

Insertion in: B1: bit 5

B2: bit 5 of the first byte

B3: bit 5

LP-BIP (VC-12): bits 1 and 2 in V5 byte

LP-BIP (VC-3): bit 5 in B3 byte of VC-3 POH

Error insertion with an equivalent bit error ratio

As an even number of errors in the parity bytes is counted as "0 errors", errors are increasingly "compensated out" as the error ratio rises.

To minimize this effect, the generation of errors with a certain error rate is corrected by the factor 1/C (see under "Evaluation of parity bytes and bits, page 8-44).

The measured error ratio is then multiplied by C to obtain the equivalent error ratio (see under "Evaluation of parity bytes and bits, page 8-44).

Error insertion in the pointer

Insertion AU-NDF enabled (1001):
AU-NDF (new data flag) enabled: Inversion of the first four bits in the H1 byte from 0110 (NDF disabled) to 1001.

Insertion TU-NDF enabled (1001) for VC-12:
TU-NDF (new data flag) enabled: Inversion of the first four bits in the V1 byte from 0110 (NDF disabled) to 1001.

Insertion TU-NDF enabled (1001) for VC-3:
TU-NDF (new data flag) enabled: Inversion of the first four bits in the V1 byte from 0110 (NDF disabled) to 1001.

FEBE (far end block error) insertion

VC-4 POH, VC-3 POH
Inserted in: G1 bit 1 (= HP-FEBE for VC-4, LP-FEBE for VC-3)

VC12 POH
Inserted in: V5 bit 3 (= LP-FEBE)

Error triggering

Single errors . . . . . by keystroke

Error rate, settable . . . . . 1×10^{-8} to 1×10^{-2}
valid for B1inv, AU-NDF, TU-NDF, STM byste, STM bit, STM byte MF and STM slip errors.

FAS/NFAS errors . . . . . 1×10^{-8} to 1×10^{-1}

B2 errors . . . . . 1×10^{-8} to 2×10^{-3}

B1, B3, LP-BIP, HP-FEBE, LP-FEBE errors . . . . . 1×10^{-8} to 5×10^{-4}

Mantissa setting range . . . . . 1 to 9

Exponent setting step width 1

A sequence of errors can be inserted in addition to the error insertion indicated in section 8.1.4.1:

A bit error is inserted in M consecutive frames into one of the following: FAS, B1, B2, B3 or any bit of the frame after scrambling. The sequence is repeated after N frames.

Setting range for N . . . . . 1 to 11

Number of errors M . . . . . $M \leq N$

Additional error insertion for error types "STM byte" and "STM byte MF":

Between 1 and 8 bits in any byte of the STM-1 frame or multiframe can be inverted. This can be done for N consecutive frames. Error insertion is triggered by pressing a key (SINGLE) or can be repeated at set intervals (PERIOD).

Setting range N Frames . . . . . 1 to 999

Setting range PERIOD . . . . . 0.2 to 9.9 s

V.11 interface [53]

Insertion of SOH/POH bytes via the V.11 interface (ITU-T X.24 and X.27):

Dynamic loading of n*64 kbit/s channels per frame in real time using contradirectional clock and synchronization signals (active 0).

The clock signal is smoothed. Sampling is done on the falling clock edge.

64 kbit/s: 1 byte per frame

128 kbit/s: 2 bytes per frame

192 kbit/s: 3 bytes per frame

576 kbit/s: 9 bytes per frame

Connector [53] pin assignments

Pin no.	Signal	Input/output
1	Ground	
2	Data (inv)	Input
3	nc	
4	nc	
5	Control	Output
6	Clock	Output
7	Sync	Output
8	Ground	
9	Data	Input
10	nc	
11	nc	
12	Control (inv)	Output
13	Clock (inv)	Output
14	Sync (inv)	Output
15	nc	

nc = not connected
inv= inverted signal
Indicate and Indicate (inv): fixed at "0"

STM-1 trigger [52]

Selectable use as input or output.

Output

Frame trigger:

One positive trigger pulse (length 25 ns) per TX frame

or multiframe trigger:

One positive trigger pulse (50 ns) during column 260 row 9 of the last multiframe

or:

8 kHz signal with approx. 50% duty cycle. Derived from system bit rate for synchronizing external equipment.

Output impedance . . . . . approx. 75 Ω

"High" output voltage (open circuit) . . . . . > 4.5 V

"Low" output voltage (open circuit) . . . . . < 0.5 V

Max. permitted peak input voltage . . . . . 5 V

Input

Signal for synchronizing the TX frame or multiframe to an external positive trigger pulse (length ≥ 200 ns)

Input impedance . . . . . > 10 kΩ

"High" input voltage . . . . . > 2.0 V

"Low" input voltage . . . . . < 0.8 V

Max. permitted peak input voltage . . . . . ± 5 V

8.4.1.4 Receiver

Test signals for bit error measurements

The unpacked 140 Mbit/s or the unpacked 34 Mbit/s signal from one of the 3 TU-3s or 2 Mbit/s signal from one of the 63 selectable TU-12s is available for the bit error measurement.

As an alternative to this, one or more specified bytes from the SOH or VC-4 POH can be switched through to the pattern comparator to allow bit error measurements in the SOH and VC-4 POH channels.

If the MUX/DEMUX chain (option 3017/00.07) is used, fully structured test patterns can be analyzed.

Descrambling

7 bit polynomial to ITU-T Recommendation G.709

Polynomial . . . . . $1 + x^6 + x^7$

The first row of the SOH is not descrambled

The descrambler can be deactivated.

Evaluation of SOH, VC-4 POH and VC-3 POH

The complete SOH, VC-4 POH and VC-3 POH can be monitored (display in HEX code).

Alternatively, any SOH, VC-4 POH or VC-3 POH byte from 64 consecutive frames can be displayed (display in HEX and ASCII codes).

Bit error measurements in the SOH, VC-4 POH and VC-3 POH channels

1. One byte (64 kbit/s) per frame at any point of the SOH, VC-4 POH or VC-3 POH except B1, 3 x B2 or B3, or
2. Two bytes (128 kbit/s) per frame in K1, K2, or
3. Three bytes (192 kbit/s) per frame in D1 to 3, 3 x Z1, 3 x Z2 or Z3 to 5, or
4. Nine bytes (576 kbit/s) per frame in D4 to 12

Evaluation of VC-12 POH (V5 byte)

The following are directly accessible (display):

RFI	bit 4
Signal label (L1, L2, L3)	bits 5 to 7
LP-FERF	bit 8

The following are accessible by counter:

LP-BIP error	bits 1 and 2
LP-FEBE	bit 3

Alarm evaluation

Alarms (in order of priority)	Possible for
LOS	C-4, C-12, C-3
OOF	C-4, C-12, C-3
LOF	C-4, C-12, C-3
MS-AIS	C-4, C-12, C-3
AU-AIS	C-4, C-12, C-3
AU-LOP	C-4, C-12, C-3
LOM	C-12
TU-LOP	C-12, C-3
TU-AIS	C-12, C-3
MS-FERF	C-4, C-12, C-3
HP-FERF	C-4, C-12, C-3
LP-FERF	C-12, C-3
HP-UNEQ	C-4, C-12, C-3
LP-UNEQ	C-12, C-3
AIS	C-4, C-12, C-3

FAS/NFAS errors

The errored STM-1 frame alignment signals are evaluated and counted as word errors (max. 1 word error per frame) or as bit errors (max. 48 bit errors per frame).

The errors are converted to an equivalent bit error rate which is displayed.

Evaluation of parity bytes and bits

Evaluation is as bit errors or block errors (max. 1) per (multi) frame.

RS-BIP errors (B1), MS-BIP errors (B2), HP-BIP errors (B3), LP-BIP errors (V5 byter or B3 in VC-3 POH), HP-FEBE and LP-FEBE are counted. The errors are converted internally to an equivalent bit error rate which is displayed.

Calculating the actual parity bit error ratio from the measured bit error ratio

As an even number of errors in the parity bytes is counted as "0 errors", errors are increasingly "compensated out" as the error ratio rises.

To minimize this effect, the measured parity bit error ratio is multiplied by a correction factor C to obtain the actual error ratio which is then displayed.

The table below gives examples of measured and actual bit error ratios.

BER	B1		B2		B3	
	BERx	C	BERx	C	BERx	C
1.000E-05	9.761E-06	1.024	9.920E-06	1.008	9.769E-06	1.024
2.089E-05	1.987E-05	1.052	2.055E-05	1.017	1.990E-05	1.050
3.020E-O5	2.809E-05	1.075	2.948E-05	1.024	2.816E-05	1.073
4.365E-05	3.933E-05	1.110	4.216E-05	1.035	3.947E-05	1.106
9.120E-05	7.368E-05	1.238	8.486E-05	1.075	7.418E-05	1.229
1.000E-04	7.921E-05	1.263	9.241E-05	1.082	7.980E-05	1.253
2.089E-04	1.312E-04	1.592	1.776E-04	1.176	1.331E-04	1.570
3.020E-04	1.584E-04	1.907	2.395E-04	1.261	1.614E-04	1.872
4.365E-04	1.811E-04	2.410	3.141E-04	1.390	1.855E-04	2.353
9.120E-04	2.033E-04	4.485	4.796E-04	1.902	2.099E-04	4.344
1.000E-03	2.042E-04	4.898	4.986E-04	2.005	2.109E-04	4.741

BERx: Bit error ratio determined from the parity byte errors
BER: Corrected (actual) bit error ratio
C: Correction factor

Pointer evaluation

Display of AU absolute pointer and the TU absolute pointers.

AU pointer changes are evaluated and displayed. Au pointer increments (PTR+), decrements (PTR-) and the sum of both (PTR Σ) are displayed.

Max. permitted pointer rate . . . . . ± 250 operations per second

This pointer rate occurs at an offset of . . . . . ± 40 ppm

Pointer rate gradient . . . . . ≤ 4 pointer actions per second

Overhead compare

Any pattern from one to eight bits length can be detected in any SOH or VC-4 POH byte. Either "overhead match" (match between pattern and mask) or "overhead mismatch" (when at least one bit in the pattern differs from the mask) can be counted.

V.11 interface: [55]

Output of SOH / POH bytes via V.11 interface (ITU-T X.24 and X.27):

One byte (64 kbit/s) per frame at any point of the SOH or VC-4 POH except B1, 3 x B2 or B3,

or

Two bytes (128 kbit/s) per frame in K1, K2, or

Three bytes (192 kbit/s) per frame in D1 to 3, 3 x Z1, 3 x Z2 or Z3 to 5, or

Nine bytes (576 kbit/s) per frame in D4 to 12, or

The complete VC-4 POH (nine bytes, 576 kbit/s), or

The complete SOH (81 bytes, 5184 kbit/s)

Connector [55] pin assignments

Pin no.	Signal	Input/Output
1	Ground	
2	nc	
3	nc	
4	Data (inv)	Output
5	Indicate	Output
6	Clock	Output
7	Sync	Output
8	Ground	
9	nc	
10	nc	
11	Data	Output
12	Indicate (inv)	Output
13	Clock (inv)	Output
14	Sync (inv)	Output
15	nc	

nc = not connected
inv= inverted signal
Indicate and Indicate (inv): fixed at "0"

STM-1 trigger [54]

Selectable function as trigger output, synchronization output or for indicating loss of frame synchronization.

Output impedance . . . . . approx. 75 Ω
Output voltage "High" (open circuit) . . . . . > 4.5 V
Output voltage "Low" (open circuit) . . . . . < 0.5 V
Max. permitted peak input voltage . . . . . ± 5 V

Trigger output

One positive trigger pulse (50 ms) in the last frame of the multiframe cycle

Synchronization output

- 8 kHz signal, duty cycle 50%, derived from RX clock signal
- or for STM1-C12: 2048 kHz clock signal of the multiframe

Loss of frame sync. signal

Signal is set to "High" when frame synchronization is lost (OOF)

8.5 Optical interface, option BN 3017/00.02

Bit rate range for NRZ . . . . . 20 to 175 Mbit/s
Bit rate range for CMI . . . . . 10 to 100 Mbit/s

Optical connectors:
Internal plug connectors . . . . . 2.5 mm (PC)

Test adapters "fiber-to-fiber" for direct connection of
various 2.5 mm plug connectors. . . . . DIN, FC-PC, ST, HMS-10
Fiber . . . . . single mode, 9/125 µm

8.5.1 Optical transmitter [38]

To ITU-T Recommendation G.957, Application code I-1 and S-1.1
Output level at 155520 kbit/s:
NRZ, 2^{23}-1 . . . . . typically -8 dBm
minimum -12 dBm
maximum -5 dBm
Wavelength . . . . . 1310 ± 50 nm
Laser class 1
The optical transmitter is activated / deactivated via the menu.

8.5.2 Optical receiver [39]

To ITU-T Recommendation G.957
Wavelength range . . . . . 1100 to 1570 nm
Sensitivity:
Receive level at 155520 kbit/s
NRZ, 2^{23}-1, 1310 nm . . . . . -8 to -32 dBm
from series C onward . . . . . -8 to -34 dBm

8.6 Printer

8.6.1 Internal printer

Thermal printer, 27 characters per line.

Printout

The form of the printout depends on the operating mode selected for the instrument.

All important settings and results are printed out:

- Error evaluation
- Histogram (diagram of results versus time)
- Automatic measurement sequences
- Setups

Print trigger

- Manually by pressing the "PRINT" key
- Automatically at the end of the programmed gate time
- Automatically at the end of the programmed gate time and when a programmed threshold is reached.

Stop printout

- Manually by pressing the "STOP/PAPER" key

Manual paper feed

By pressing the "STOP/PAPER" key when printer is stopped

8.6.2 External printer connected to RS 232 interface [45]

If the V.24 interface is not used for remote control (see section 4), an external printer can be connected to the SF-60 via this interface. A screen dump of the current SF-60 display can then be made.

Printer types

The following printers can be connected:

- HP Deskjet
- HP Laserjet
- IBM Proprinter
- Epson FX

Printer connection

To connect the printer, you will need the following accessory:

- Printer cable K751 (available from Wandel & Goltermann)

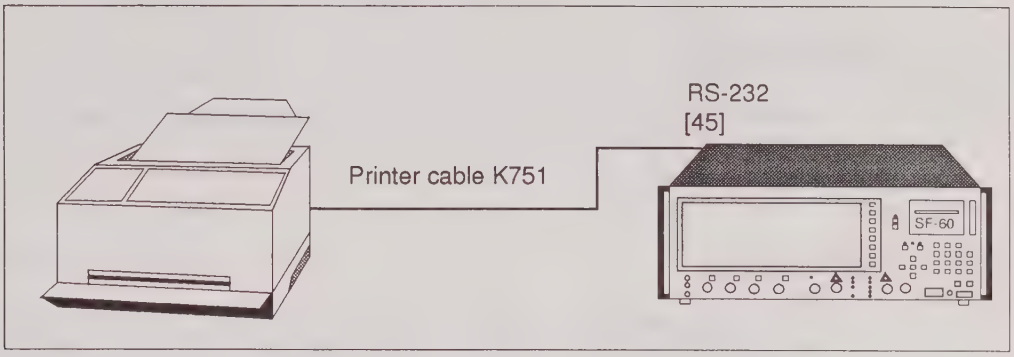


Fig. 8-5 Printer connection using cable K751

Connections between SF-60 and printer

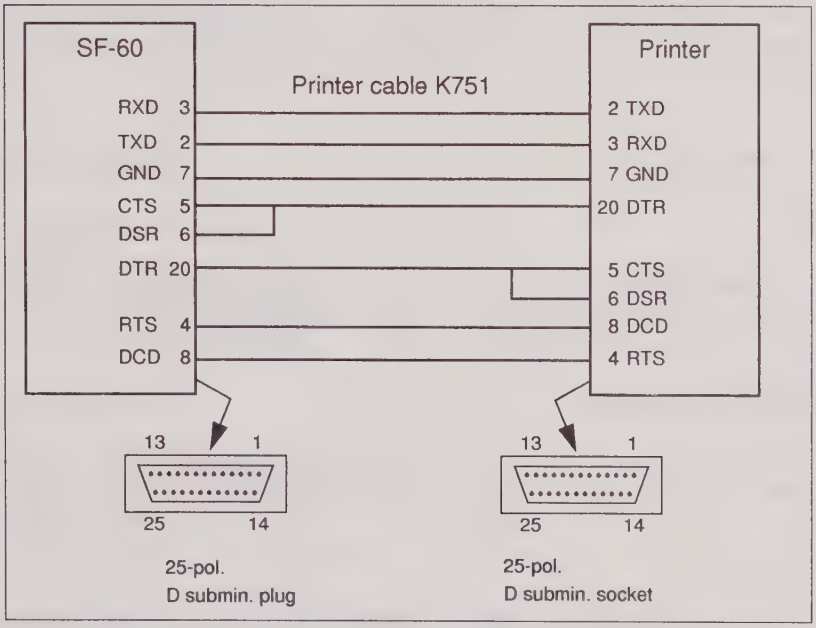


Fig. 8-6 Connector pin assignments for Sf-60 and printer interfaces

Menu settings

To use an external printer, make the following settings:

1. In the "Configuration" sub-menu of the "Test & Configuration" menu (TEST/CONF key), set the V.24 "Mode" parameter to "Printer".
   The other V.24 parameters must also be matched to the printer you are using.
2. Select "External" for "Print device" in the "Printer" menu and select the appropriate printer type.
3. Press the PRINT key [9] to output the current screen contents as a screen dump to the external printer.

8.7 Device setups

Device setups can be stored and recalled by the user as required.

8.7.1 Internal setups

Stored setups are retained in memory when the instrument is switched off or if the power supply fails

Max. number of setups stored 10

8.7.2 Memory card

Setups together with all relevant parameters can be stored on the memory card

Number of setups for 64k memory volume 20

8.7.3 Sequence

A pre-set sequence of setups (internal and memory card) can be run by specifying the start setup number and the end setup number. The sequence runs automatically after "START" is pressed: Each setup is recalled and set and a measurement made automatically. The results are output together with the measurement number.

8.8 Internal device tests

8.8.1 Self test

All RAMs and ROMs are checked, an I/O test is performed and the display and front panel LEDs are switched on each time the instrument is switched on.

8.8.2 Function test program

The more important instrument functions can be tested by linking the generator output [30] to the receiver input [36]; see section 2.4.3 "Switching on"

8.9 Remote control

All device functions can be remote-controlled with the exception of the paper feed function ("STOP/PAPER" key) and the display controls.

Remote control is via the GPIB interface [44] and the RS 232 interface[45]. Modem control (Hayes) is possible via the RS 232 interface.

Both interfaces are described in chapter 4 "Remote control".

8.10 General instrument functions

8.10.1 Temperature monitoring

The instrument is ventilated by a dual-speed fan; speed switching is temperature controlled.

The filter pads in the air intake can be exchanged (see section 7.2.5 "Changing the air filters").

If the ambient temperature is too high or the air flow is obstructed, the internal power supply unit switches off automatically. After cooling down, the instrument must be switched on again manually.

8.11 General specifications

8.11.1 Power supply

A.C. line voltage, 2 ranges, switchable:

Nominal voltage range	Operating range
100 to 127 V	90 to 140 V
220 to 240 V	193 to 264 V
Power consumption	330 VA
A.C. line frequency	50 / 60 Hz ± 5%
Safety class to IEC 1010-1	1

8.11.2 Ambient conditions

Ambient temperature

Operating range	+5 to +40 C
Limits operating range for 2 h	-10 to +55 C
Storage and transport range	-20 to +70 C

Air humidity

Operating range:

Relative humidity (30 C)	5 to 85%
Absolute humidity (> 30 C)	≤ 25 g/m^3

The printer paper is not included in this specification.

Condensation

Occasional short-term condensation is permitted as a limit condition.

8.11.3 Electromagnetic compatibility (EMC)

Spurious emissions

This instrument fulfils the requirements of EN 50 081-1 and thus the limit class B of EN 55 022 (identical to CISPR 22:1985 modif., DIN VDE 0878 Part 3) and of FCC Rules Part 15 Subpart J Class A. The instrument meets the safety targets of European Directive 89/336/EWG of May 3, 1989 with respect to spurious emissions. No special operating permit is required.

This instrument has been inspected such that the requirements for spurious emissions from this instrument are also met when it is used as part of a system.

The prerequisite is a correctly designed system and the use of proper connection cables, with special attention paid to the presence of sufficient shielding.

If the device under test (DUT) to which this instrument is connected can produce spurious emissions itself (e.g. if the connection to the DUT is not uniformly shielded), the operator must take pains to ensure that no unallowed spurious emissions are generated. Suitable shielding must be provided.

Intrinsic stray fields (magnetic)

for a 50 Hz line frequency at a distance of 30 cm . . . . . ≤ 4 A/m

Immunity to external magnetic fields at the a.c. line frequency

Fully functional up to. . . . . 12 A/m x 50/f

Immunity to electrostatic discharge per IEC 801-2

*Reduced functioning, automatic recovery up to . . . . . 8 kV

Immunity to electromagnetic fields per IEC 801-3

Fully functional up to. . . . . 3 V/m
in the frequency range. . . . . 26 to 1000 MHz

Immunity to rapid, transient disturbances per IEC 801-4

On the supply network

*Reduced functioning, automatic recovery up to . . . . . 1 kV

On the signal lines

*Reduced functioning, automatic recovery up to . . . . . 500 V

Immunity to impulses of mean energy (1.2/50 µs) on the supply network per IEC 801-5

*Reduced functioning, automatic recovery up to . . . . . 1 kV

Immunity to line-conducted noise per IEC 801-6

*Reduced functioning, automatic recovery up to . . . . . 3 V
in the frequency range. . . . . 150 kHz to150 MHz

Overvoltage immunity to high-energy impulses on the supply network per VDE 0160

No functional failure up to . . . . . 0.3 ms/750 V

*Definition of "Reduced functioning, automatic recovery up to":

During the impairment, the signal received by the instrument can be impaired such that an error is detected. This can be a code error, for example, and depending on the point in time, a bit, FAS or parity error. Error bursts can cause alarms. The errors or alarms occur only during the impairment.

To minimize the influence of the impairment, the system must be correctly designed and the proper connection cables used. Sufficient shielding must also be provided.

8.11.4 EEC conformity declaration/CE mark

This instrument conforms to the requirements of EN 50 081-1 and EN 50 082-1, see EEC conformity declaration for details.

8.11.5 Noise emission to EEC guideline for machinery 89/392/EEC

Sound pressure level at 1 m distance
under normal operating conditions . . . . . approx. 40 dB(A)
at temperatures above 30 °C (fan on speed 2) . . . . . approx. 52 dB(A)

8.11.6 Mechanical specifications

Bench-top model:
Dimensions (w x h x d) in mm . . . . . 477 x 244 x 475
(BN 700 casing with 50 mm extension)
Weight without options . . . . . 20 kg
with options . . . . . 24 kg

8.11.7 Ordering information, options and accessories

8.11.7.1 PDH/SDH error and jitter analyzer, mainframe

Instrument without frame generator, jitter generator, quad output and optical interface;
Version with menu texts in English (can be switched to German). . . . . BN 3017/01
Version with menu texts in German (can be switched to English). . . . . BN 3017/02
Version with menu texts in Spanish (can be switched to English). . . . . BN 3017/03

8.11.7.2 Options (fitted ex-works, charged extra)

PDH 2/8/34 Mbit/s and 2/34 Mbit/s frames . . . . . BN 3017/00.09
PDH 140 Mbit/s frames . . . . . BN 3017/00.08
SDH frames (STM-1, C-4). . . . . BN 3017/00.05
SDH frames (STM-1, C-12) . . . . . BN 3017/00.03
SDH frames (STM-1, C-4 + C-12). . . . . BN 3017/00.04
SDH frames (STM-1, C-3). . . . . BN 3017/00.06
MUX/DEMUX chain . . . . . BN 3017/00.07
Evaluation to ITU-T Recommendation G.826 . . . . . BN 3017/00.52
Jitter generator . . . . . BN 2074/00.15
Optical interface (alternative to quad output)
1300 nm . . . . . BN 3017/00.02
Quad output (alternative to optical interface) . . . . . BN 2074/00.10
Clock divider 155 Mbit/2 Mbit . . . . . BN 3017/00.18
Calibration certificate to ISO 10012-1 . . . . . BN 3017/00.13

8.11.7.3 Accessories

Included with instrument

2 air filter pads
1 roll of printer paper
1 Memory Card, S64K
A.C. line cord
Connecting cables for IEC 625 remote control
V.24 interface driver diskette
Instrument handbooks

Optional accessories (charged extra)

1 roll of printer paper	BN 2040/00.05
2 Memory Cards, S64K	BN 2110/00.02
Connecting cables for IEC 625 remote control	K420
RS-232 interface cable	e.g. K512
Printer cabel for external printer	K751
6 air filter pads	BN 2040/00.04
Set of front and rear panel covers SD-5	BN 700/00.25
19" conversion kit	BN 700/00.05
LabWindows driver	BN 3017/95.99

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